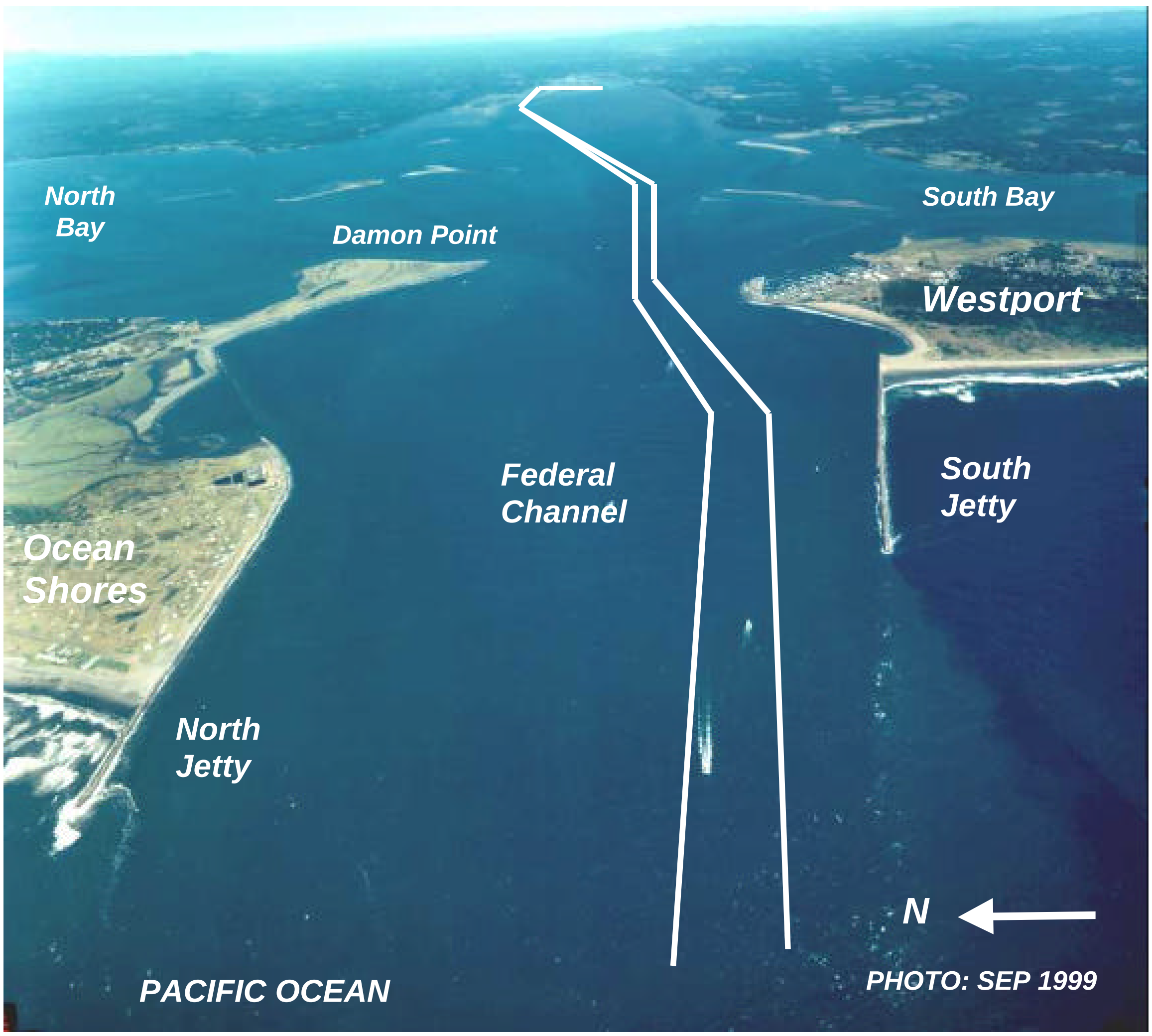
Programmatic Biological Evaluation

Fiscal Years 2001-2006 Maintenance Dredging and Disposal
Grays Harbor Navigation Project
Grays Harbor County, Washington

December 2000



US Army Corps of Engineers®
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1. INTRODUCTION

The Grays Harbor navigation channel provides shipping access between the Pacific Ocean and Cosmopolis on the Chehalis River, Grays Harbor County, Washington. The navigation channel, which is 23.5 miles long, is dredged annually by the U.S. Army Corps of Engineers in order to maintain authorized project depths. Without annual maintenance dredging, shoaling would reduce the ability of larger ships to enter and leave the inner harbor safely under full load or low tide conditions, thereby impacting the economy of Grays Harbor county.

The original Grays Harbor navigation channel was authorized by Congress in the Rivers and Harbors Act of 1896. The Grays Harbor and Chehalis River project and maintenance dredging by the Department of the Army were authorized by the Rivers and Harbor Act of 1935 and modified by the Act of 1945, the Act of 1954, and the Water Resources Development Act of 1986 (Public Law 99-662). Copies of authorizing documents are on file at the Seattle District Office.

Prior to the construction of the north and south jetties (1898 to 1910), depths over the outer bar were as shallow as 15 feet, and early navigation charts of the area warned of breakers extending entirely across the entrance to Grays Harbor. When the jetties were originally constructed, they were inadequate to maintain project dimensions in the Bar Channel, so dredging began in 1916 and continued at regular intervals until 1942 when the scouring effect of longer and higher jetties could create sufficient depths for navigation. Due to the scouring effect of the jetty system, no maintenance dredging was required in either the Bar or Entrance Channels between 1942 and 1990. In 1990, the Bar Channel was deepened to -46 feet MLLW as part of the Grays Harbor Navigation Improvement Project, which was authorized by Section 202 of the Water Resources Development Act of 1986 (Public Law 99-662) in November 1986. As a consequence of deepening the channel, maintenance dredging is again required in the Bar and Entrance channels.

This Programmatic Biological Evaluation (PBE) has been written for five years of maintenance dredging and disposal of an estimated annual 2,500,000 cubic yards (cy) of sediment from the deep draft Grays Harbor and Chehalis River Navigation Project. This PBE addresses the potential effects of the Grays Harbor maintenance program on listed, proposed, and candidate species within the project area. Potential impacts of the dredging on species of commercial value will be addressed in a forthcoming NEPA Environmental Assessment. If any additional species are listed as threatened and/or endangered during the life of the PBE (2001-2005), re-initiation of consultation will occur immediately.

2. DESCRIPTION OF PROJECT AREA AND ACTION AREA

The action area for this project consists of the lower mainstem Chehalis River, Grays Harbor, and the Pacific Ocean off the Harbor's mouth (T17N, R10 W, Sections 9, 10, 11, 12, 13 and T17N R9W Sections 8, 9, and 10).

The Chehalis River Basin originates in the Willapa Hills of southwest Washington and flows to the Pacific Ocean via Grays Harbor, draining approximately 2,170 square miles. Basin topography varies from rolling uplands and fertile river valleys of the Willapa Hills to the south and east, to foothills of the Olympic Mountains to the north. Higher elevations in the basin are rugged and densely forested, but near the city of Chehalis the river emerges onto a broad, flat valley and meanders until emptying into eastern Grays Harbor. Land in the Chehalis valley is extensively farmed, and a large portion of the basin is in timber production. The lower mainstem Chehalis has a low gradient and a number of sloughs and side channels. Depending on flow in the Chehalis and tide height, tidal influence may extend as far upstream as the Wynoochee River at river mile 13. The streambed ranges from 50 to 300 yards wide and consists primarily of gravel, sand, and silt (Phinney and Bucknell 1975).

Grays Harbor (Figure 1) is at the mouth of the Chehalis river on the southwestern coastline of Washington, approximately 110 miles south of the entrance to the Strait of Juan de Fuca and 45 miles north of the Columbia River's outfall. Fresh water inflow to the estuary comes predominantly from the Chehalis, Hoquiam, and Humptulips Rivers.

The predominant physical feature of the Harbor is the expansive mudflats that cover 63% of the Harbor's surface area at low tide (MLLW); the water surface ranges from about 94 square miles at mean higher high water (MHHW) to 38 square miles at MLLW. Numerous shallow channels have been cut into the mudflat areas of the North, South, and East Bays by ebbtide flows and discharge from the Humptulips, Elk, and Chehalis Rivers, respectively. Harbor sediments are composed of ocean-borne sands in the outer estuary and river-borne silts near river outfalls in the North, South, and East Bays. A mixed transition zones lies between the two in a broad band.

A variety of habitats occur in the Harbor; these habitats and the organisms occupying them were described extensively by USFWS (1982). Deeper subtidal habitat (i.e., the navigation channel) is primarily man-made. Channel habitat largely consists of the dredged navigation channel running the length of the Harbor west from Cosmopolis. Characteristic channel fauna include several species, including starry flounder, staghorn sculpin, sharks, lingcod, and salmon. Other fish species that occur in Grays Harbor include forage fish such as herring (*Clupea harengus*), surf and longfin smelt (*Hypomesus pretiosus, Sprinichus thaleichthys*), and anchovy (*Engraulis mordax*). These fish are an important source of food for the larger fish found in the bay.

Sub- and intertidal mudflat habitat radiates from the mouths of major rivers emptying into the estuary. Epibenthic green and blue-green algae and diatoms are the predominant flora, while zooplankton is dominated by copepods and mysids. Softshell clams (*Mya arenaria*), bent-nose clams (*Macoma nasuta*), and polychaete worms dominate the benthos. Mudflats support a wide variety of avian species, such as the western sandpiper, sanderling, yellowleg, dunlin, dowitcher, curlew, western grebe, scoter, cormorant, and great blue heron. Starry flounders, staghorn sculpins, and sticklebacks are the most common resident fish species; mudflats are of special value to juvenile salmonids during their outmigtation.

Subtidal sandflat habitat is found in the western Harbor and is generally bounded toward the nearshore by eelgrass beds at the point where coarse ocean sands begin to mix with finer river-borne silts. Epibenthic algal production is low in sandflat areas, so detrital and deposit feeders are less abundant than in mudflat habitat. Ephemeral sand spits and islands are important nesting and foraging areas for the threatened snowy plover.

Eelgrass (*Zostera spp.*) habitat occurs in areas with moderate current velocities and substrates composed of a mix of sand and silt. In Grays Harbor, eelgrass is generally limited to –3' MLLW because of high turbidity. Areal extent and density may change from year to year as old beds are uprooted and new ones established. Eelgrass habitat provides food, shelter, and substrate for an abundance of marine organisms, thus increasing the biological productivity and diversity of the estuary. Benthic fauna include nereid worms, clams, nematodes, and burrowing anemones. Eelgrass blades support isopods, amphipods, hydroids, bryzoa, harpacticoids, snails, limpets, protozoa, ciliates, and nudibranchs. Juvenile salmonids, striped sea perch, pipefish, and blennies find food and cover in eelgrass beds. Flatfish, crabs, and moon snails can be found in the epibenthos. Eelgrass is also an important food item for waterfowl, particularly the black brant and widgeon.

Emergent vegetation fringes the estuary in areas of tidal influence and low-energy wave conditions. Characteristic marsh flora include three-square bullrush (*Scirpus americanus*), arrowgrass (*Triglochin moritimum*), spike rush (*Eleocharis macrostachya*), sand spurry (*Spergularia marina*), salt grass (*Distichlis spicata*), bullrush (*Scirpus validus*), and Lyngby's sedge (*Carex lyngbyei*). Grays Harbor marsh habitats have been extensively modified during the past century, although losses slowed substantially after 1972. Marsh habitats support the black brant, Canada goose, scaup, mallard, widgeon, canvasback, bald eagle, kestrel, muskrat, vagrant shrew, and Townsend's vole.

The continental shelf along the Grays Harbor coast varies from 30 to 36 miles in width. The continental slope then extends from about the 600-foot depth contour to abyssal ocean depths. The coast is subjected to the full impact of severe winter storm-produced waves. This winter wave environment produces turbulent mixing of surface and bottom waters over the continental shelf, which affects biological productivity, water column characteristics, and sediment transport processes. The shelf area is influenced heavily by the discharge of the Columbia River, which flows northward during the winter months. During the summer months, climatic conditions shift this flow southward and move coastal surface waters offshore, causing upwelling that supports high biological productivity.

The mouth of Grays Harbor is constricted by two sand spits, Point Brown to the north and Point Chehalis to the south, which were formed by coastal processes in recent geologic time. Before the jetties were constructed, sediment was carried into the Harbor by the flood tide, and out of the Harbor with the ebb tide. These sediments formed a large shoal west of the Harbor's inlet. This shoal was broad and shallow, and restricted safe navigation into the Harbor. The construction of jetties at the Harbor mouth confined tidal currents, and created scouring velocities that deepened the entrance channel.

Figure 1. Grays Harbor, Washington

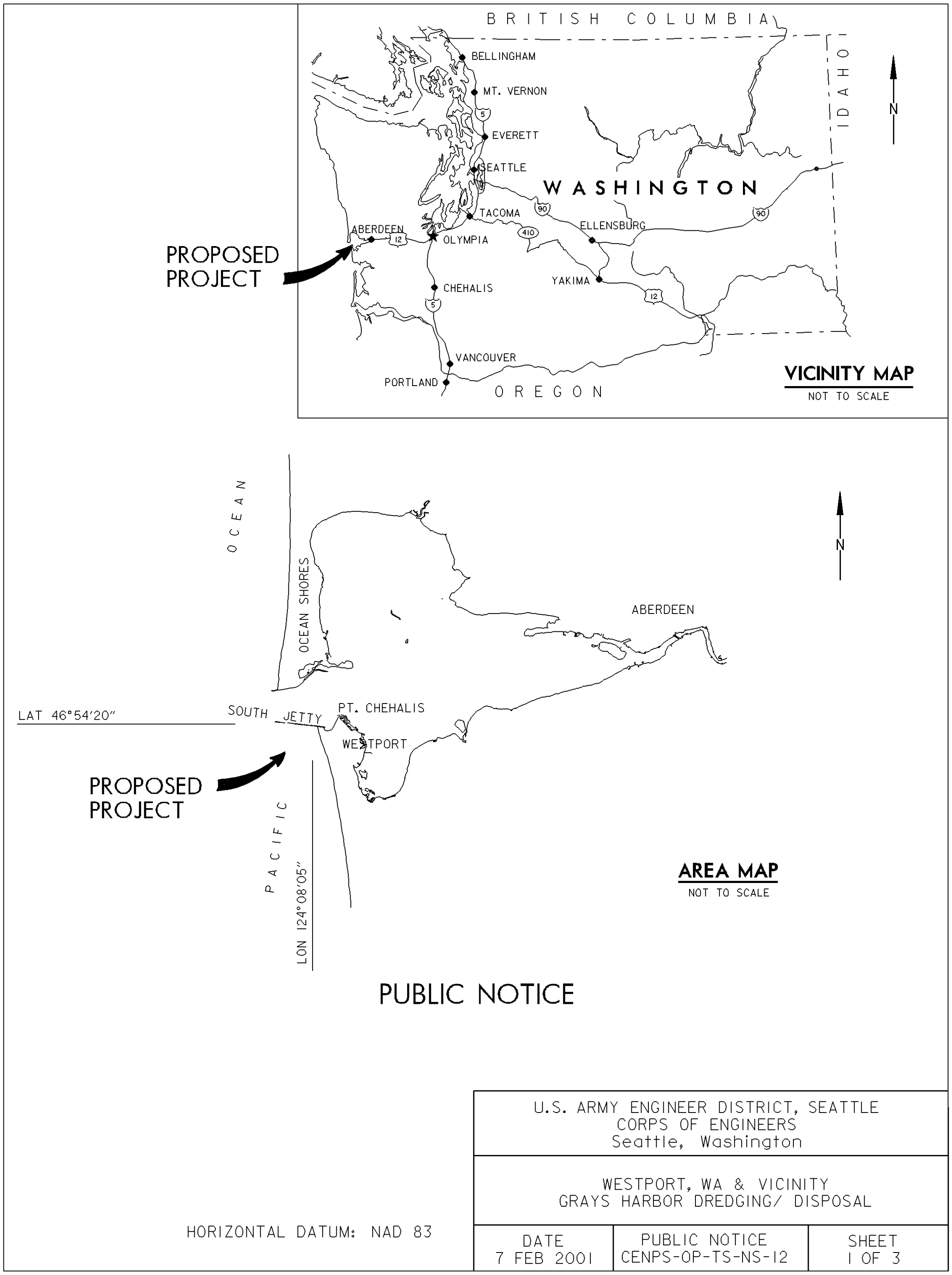
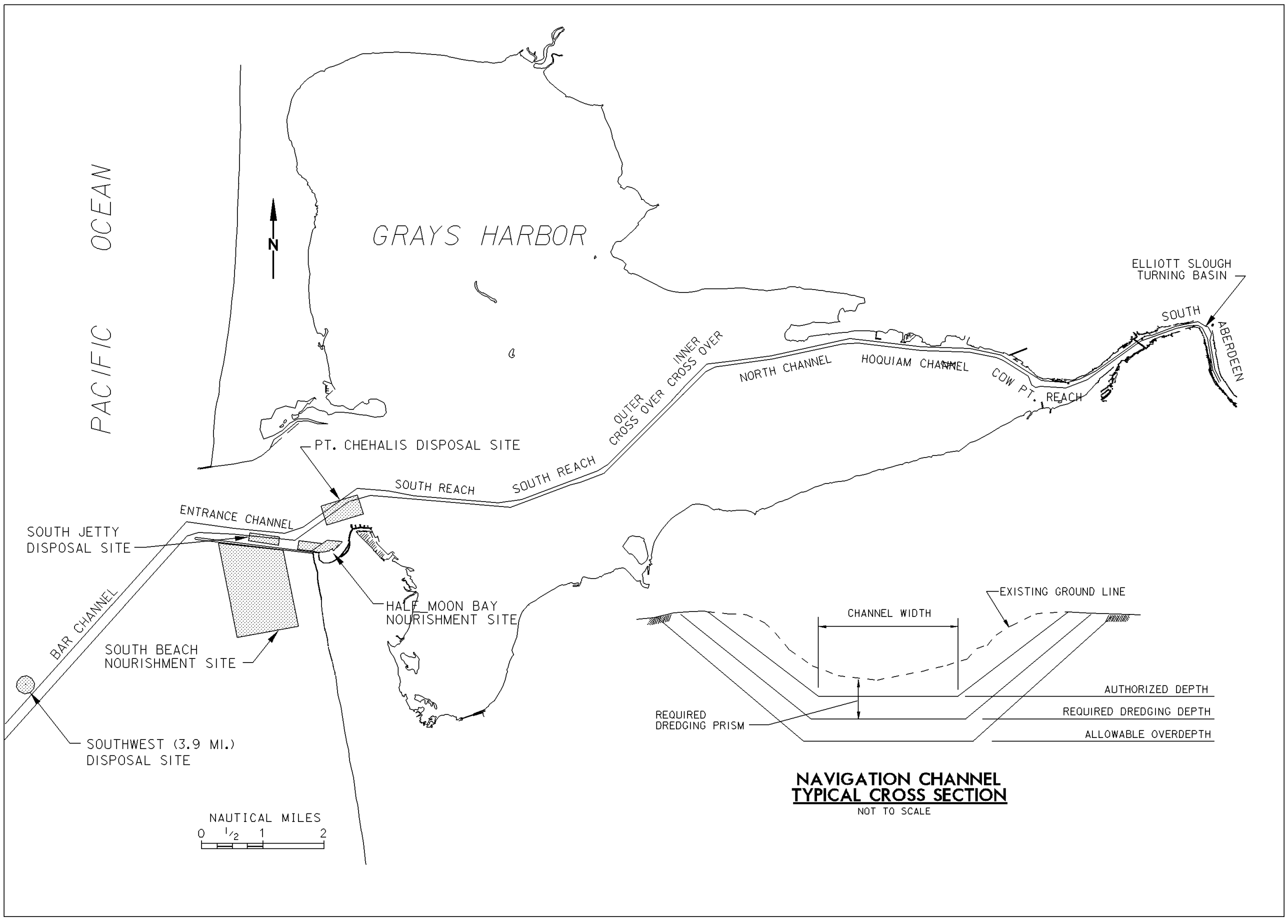


Figure2. Grays Harbor Navigation Channel Reaches and Disposal Sites



3. PROJECT DESCRIPTION

3.1 Dredging

The 23.5 miles of the Grays Harbor Navigation Channel have been divided into 10 different reaches. The downstream reaches are Outer Crossover, South Reach, Entrance, and Bar Channel, while Elliott Slough Turning Basin, South Aberdeen, Cow Point, Hoquiam, North Channel, and Inner Crossover, constitute the upstream portion of the navigation project. Please see Figure 2 for the locations of these reaches and a typical channel cross section. Typically, only one reach is dredged at a time, and the different reaches have different dredging requirements (i.e., volume dredged, annual vs. biennial scheduling) as a result of different shoaling rates. The material dredged from the Bar, Entrance, and South Reach channels consists mainly of ocean sands deposited by tidal action and silty sand and sandy silt, redistributed within the estuary by wind and wave action. Materials dredged from the inner reaches is primarily suspended/ bedload material from tributary streams and rivers. All of the sediments have been tested under Corps, EPA, and Ecology Dredged Material Management Program (DMMP) guidelines, and approved for open water disposal. Additional sediment sampling and analysis will occur on a regular basis as specified in the *Grays Harbor/Willapa Bay Dredged Material Evaluation Procedures*.

The side slopes of the navigation channel vary throughout the Harbor. Slopes progressively steepen towards the mouth of the Chehalis, since finer substrates are more cohesive and can therefore maintain a steeper slope. Representative slopes range from 1V:3H in the South Aberdeen, Cow Point, and Hoquium reaches, to 1V:5H in the North, Crossover, and inner portion of the South Reach channels, to 1V:10H in the outer potion of South Reach, Entrance and Bar reaches.

Below is a brief description of dredging requirements for the inner and outer reaches. Table 1 summarizes volume, channel dimension, disposal site, and timing information specific to individual reaches.

Inner Reaches

Approximately 1,565,000 cy are expected to be dredged annually from the inner reaches of the navigation channel. The inner portion of the Grays Harbor channel is four miles long, and extends from the Port of Grays Harbor Terminal 4 at Cow Point upstream through the Highway 101 bridge to 900 feet above the Weyerhaeuser terminal. The turning basin is located at the 90-degree river bend near the mouth of Elliot Slough. Based on recent surveys of these reaches, the channel is typically 31 to 32 feet deep, with some portions deeper and some shoals to -30 feet MLLW. The dredging will target shoals in the existing channel footprint in order to deepen to control depths between -32’ and -36’ MLLW. In order to avoid adverse salmonid impacts, the Corps will abide by timing restrictions designated by USFWS. No dredging will occur in these reaches from February 15 until July 15 of any year. Material dredged from these reaches will be disposed at the South Jetty site, or the Point Chehalis site during adverse weather/wave conditions, or if the South Jetty site is full. These reaches are maintained using clamshell dredges.

Outer Reaches

Approximately 1,250,000 cy are expected to be dredged annually in the outer reaches of the navigation channel. These reaches will be maintained using a hopper dredge between April and May. No timing restrictions related to threatened or endangered species apply to the outer reaches because of the expansiveness of the estuary in this area, a characteristic which reduces the potential for adverse impacts on salmonids in two ways. First, the channel is not in a confined portion of the estuary, so a smaller proportion of the migratory pathway is affected by sediment plumes. Second, the relative distance between dredging activities and the shallow subtidal habitat where foraging occurs is greater. However, no hopper dredging is allowed after May 31 to avoid significant crab impacts. If the dredging is not completed by May 31, a clamshell dredge will be used to complete the maintenance work. Materials dredged from the outer reaches may be disposed of at the South Jetty, Point Chehalis, 3.9 mile open water sites, or the Half Moon Bay and South Beach nourishment sites, depending on regulatory, tidal, weather, and sea conditions.

Table 1. Project Summary by Reach

REACH	ESTIMATED VOLUME (CUBIC YARDS)	DREDGE TYPE	DIMENSIONS	DISPOSAL AREA	WORK CLOSURES	WORK SCHEDULED
Elliott Slough Turning Basin	60,000 silt/sand biennially	Clamshell	-32’ to -35’ MLLW by 535’ wide	South Jetty or Point Chehalis (W)	15 February to 15 July	16 July to 14 Feb
S. Aberdeen	55,000 silt/sand annually	Clamshell	-32’ MLLW by 300-550’ wide	South Jetty or Point Chehalis (W)	15 February to 15 July	16 July to 14 Feb
Cow Point	950,000 sandy silt annually	Clamshell	-36’ MLLW by 350-725’ wide	South Jetty or Point Chehalis (W)	15 February to 15 July	16 July to 14 Feb
Hoquiam	150,000 sandy silt annually	Clamshell	-36’ MLLW by 350’ wide	South Jetty or Point Chehalis (W)	15 February to 15 July	16 July to 14 Feb
North Channel	150,000 silty sand annually	Clamshell	-36’ MLLW by 350’ wide	Point Chehalis	None	August to Feb.
Inner Crossover	200,000 silty sand annually	Clamshell	-36’ MLLW by 350-450’ wide	Point Chehalis	None	August to Feb
Outer Crossover	200,000 silty sand annually	Hopper or Clamshell*	-36’ MLLW by 350’ wide	Point Chehalis	No hopper after 31 May	April and May
South Reach	400,000 sand annually	Hopper or Clamshell*	-36’ MLLW by 350-450’ wide	Point Chehalis or Half Moon Bay	No hopper after 31 May	April and May
Entrance	400,000 sand annually	Hopper	-40’ to -46’ MLLW by 600-900’ wide	South Jetty or Half Moon Bay or Point Chehalis	No hopper after 31 May	April and May
Bar Channel	250,000 sand as needed	Hopper	-46’ MLLW by 900’ wide	South Beach or South Jetty or 3.9 mile ocean site	No hopper after 31 May	April and May

Notes:
(W)=Adverse weather/waves relief site; * A clamshell dredge is used after May 31
Depths shown are authorized depths and do not include advanced maintenance (2’) or overdepth tolerance (2’). The South Aberdeen reach has 0’ advance maintenance and 1’ overdepth. Widths shown are those of the channel bottom. Please see the “Navigation Channel Typical Cross Section” view in Figure 2.

3.2 Disposal

Three state-owned dredged material disposal sites are located directly adjacent to the navigation channel: Pt. Chehalis, South Jetty, and Southwest (3.9 mile). Please see Figure 2 for the location of these sites, which are discussed individually below. Material disposed in the South Jetty and Pt. Chehalis sites is rapidly dispersed, while material disposed at the Southwest site tends to mound. In addition, material dredged from the sandy outer reaches of the channel is periodically used for both direct and nearshore beach nourishment at Half Moon Bay, and nearshore placement at South Beach. The determination of which site will be used during the course of maintenance dredging is based on a number of factors, including yearly surveys of the disposal areas, and on weather and wave conditions at the time of disposal. Likewise, placement of material at the direct and nearshore nourishment sites depends upon the surveyed depth of the nourishment areas as well as meeting the requirements of the inter-agency mitigation agreement for the Point Chehalis revetment extension project.

Dredged material will be transported to disposal sites by either a bottom dump hopper dredge or by a tugboat and bottom-dump (split-hull) barge. These vessels generally have the ability to transport between 800 and 3,000 cubic yards of material each trip. The number of barge discharges per day is typically between three and five, but this number varies depending on the extent of the dredging activity ongoing at the time. A hydraulic pipeline is utilized at the Half Moon Bay direct beach nourishment site.

Point Chehalis Open Water Disposal Site

The depth of this site varies between -50 to –70' MLLW. It is a high energy area with a predominately westward current. The irregular bottom consists of fine to medium sized sand grains of marine origin. Historically, this site has been extremely deep. Charts that predate jetty construction show depths of –100' MLLW in this area. Over 30 million cubic yards of dredged material have been placed in this area since 1977, at an average rate of 1.7 million cy/year (USACE 1997). Annual survey records indicate that approximately 75% of material disposed at this site erodes during the dredging period, and that another 15% erodes during the following winter. Bathymetric surveys indicate that most of this eroded material moves seaward along the South Jetty. Disposal at this location reduces erosion of the Pt. Chehalis revetment and groins. The Point Chehalis site is the most heavily used disposal site in Grays Harbor.

South Jetty Open Water Disposal Site

The depth of this site varies between –50 to –70' MLLW. This area is subject to fast tidal currents, predominately westward, that sweep along the jetty toe. Rapid seaward erosion of disposed material occurs at this site. The irregular bottom consists of fine to medium sized sand grains of marine origin. Placement of dredged material at this site is necessary to prevent scour and undermining of the South Jetty's toe. This site is the preferred disposal area for inner harbor materials, although when the South Jetty site is full or weather/wave conditions are hazardous then inner harbor materials are disposed at the Point Chehalis site.

Southwest (3.9 mile) Open Water Disposal Site

The depth of this ocean disposal site varies between –100 and –120' MLLW. This site was designated to minimize impacts to Dungeness crabs during the construction phase of the widening and deepening project. This site is not used often because not much material is dredged from the Bar Channel, and material disposed at this site is unavailable for longshore transport (i.e., unable feed beaches to the north).

Half Moon Bay Nearshore Disposal and Direct Beach Nourishment

The purpose of the direct beach and nearshore disposal at this site is to maintain a stable beach profile (approximately 1V:60H) and to ensure that the armor stone toe of the Point Chehalis revetment is not exposed. Sandy material from Bar, Entrance, South Reach and Outer Crossover Reach channels is used both on the beach (direct nourishment), as well as in the bay as close to shore as possible (nearshore nourishment). The amount of direct beach nourishment material required will depend on loss of material during storm events and/or when the protective stockpile of sandy material fronting the revetment is depleted, in accordance with the inter-agency mitigation agreement for the Pt. Chehalis revetment extension project. Dredged material will be placed in front of the revetment above +9 MLLW, which is the mean higher high water datum at this location. Nearshore nourishment will occur in accordance with the inter-agency mitigation agreement, as bathymetric conditions permit. Nearshore nourishment will only occur when the bay is deep enough for the bottom dump barge to navigate; nourishment occurred during 1996, 1997, 1998, and 1999. Disposal in Half Moon Bay did not occur in 2000 because the area was too shallow for the bottom dump barge to gain access. Surveys will be taken each year prior to dredging, and once the navigability determination is made, all resource agencies will be notified of the decision. It is expected that during the five year term of this Biological Assessment, up to 700,000 cy of suitable sandy dredged material will be placed at the Half Moon Bay sites.

South Beach Near Shore Nourishment

The purpose of disposal at this site is to slow the erosion on the south side of the South Jetty. Sandy material from the Bar Channel is placed as close to shore as possible, generally between –30’ and –40’ MLLW. This location extends the residence time of dredged material in the littoral system while avoiding productive crabbing areas. It is expected that during the five year term of this Biological Assessment, up to 200,000 cy of Bar Channel material will be placed at the South Beach site.

4. AFFECTED SPECIES

Several species protected under the Endangered Species Act of 1973 (16 USC 1531-1544) potentially occur in the project vicinity. They are:

- Bald Eagle (*Haliaeetus leucocephalus*)
- Brown Pelican (*Pelecanus occidentalis californicus*)
- Western Snowy Plover (*Charadrius alexandrius nivosus*)
- Aleutian Canada Goose (*Branta canadensis leucopareia*)
- Marbled Murrelet (*Brachyramphus marmoratus*)

- Coastal/Puget Sound Population Segment Bull Trout (*Salvelinus confluentus*)
- Southwest Washington/Columbia River ESU Coastal Cutthroat Trout (*Salmo clarki clarki*)
- Humpback Whale (*Megaptera novaeangliae*)
- Blue Whale (*Balaenoptera musculus*)
- Fin Whale (*Balaenoptera physalus*)
- Sei Whale (*Balaenoptera borealis*)
- Sperm Whale (*Physeter macrocephalus*)
- Steller Sea Lion (*Eumetopias jubatus*)
- Leatherback Sea Turtle (*Dermochelys coriacea*)
- Loggerhead Sea Turtle (*Caretta caretta*)
- East Pacific Green Sea Turtle (*Chelonia mydas*)
- Olive Ridley Sea Turtle (*Lepidochelys olivacea*)
- Lower Columbia/Southwest Washington ESU Coho (*Oncorhynchus kisutch*)

However, there is evidence that the some of these species are not likely to regularly occur in the project's action area.

Blue whales may feed on the continental shelf off of Washington and Oregon during the summer months, however the species is most abundant off the coast of California (Reeves et al. 1998a). **North Pacific Fin whale** concentrations generally form along frontal boundaries or mixing zones between coastal and oceanic waters; no regular occurrences off the coast of Washington were noted in a 1998 draft recovery plan for this species (Reeves et al. 1998b). **Sei whales** inhabit areas along the continental slope, and rarely enter semi-enclosed marginal seas or gulfs (Reeves et al. 1998b). **Sperm whales**, while more frequently present off the coast of Washington, typically inhabit deep waters and seldom venture close to coastal areas (Barlow et al. 1997). The preferred habitat for all of these whale species is the open ocean, not coastal waters.

Leatherback turtle nesting grounds occur between 40°N and 35°S (Plotkin 1995), so no nesting areas are located in Washington. While this species may use oceanic areas off the coast of Washington as foraging grounds during the summer and fall months, aerial surveys indicate that when off the U.S. Pacific coast leatherbacks usually occur in continental slope waters (NMFS and USFWS 1998a). The nesting areas of **Loggerhead turtles** are also located in the subtropics, though primarily in the western Pacific (NMFS and USFWS 1998b). It is thought that eastern Pacific waters may be used as foraging grounds and migratory corridors. However, sightings in the eastern Pacific are generally confined to the summer months off of southern California

(NMFS and USFWS 1998b). Primary nesting sites for the **Green turtle** are located in Mexico and the Galapagos Islands, although a resident population is present in San Diego Bay (NMFS and USFWS 1998c). Beach strandings and gillnet captures have been reported off the Washington coast, but is it has been suggested that these individuals were vagrants that strayed northward with El Nino currents (NMFS and USFWS 1998c). No regular occurrences off the coast of Washington were noted in a 1998 draft recovery plan for this species. **Olive Ridley turtles** occur in tropical and warm temperate ocean waters, and eastern Pacific populations nest in southern Mexico and northern Costa Rica (NMFS and USFWS 1998d). There is evidence that they undergo regular migrations from breeding areas to feeding areas in the south. However, El Nino events may cause Olive Ridleys to migrate northward, where they "cold stun" once they encounter colder water (NMFS and USFWS 1998d).

Given the distributions of these marine mammals and sea turtles, combined with their high mobility, the Corps believes the proposed project will have **no effect** on these species.

5. ENVIRONMENTAL BASELINE AND IMPACTS OF THE PROPOSED PROJECT

The first portion of this assessment focuses on general dredging impacts, while species-specific discussions follow in Section 7. The general discussion largely focuses on effects relevant to anadromous salmonids, but the sub-section on biota addresses potential impacts on the estuarine food chain and is therefore applicable to several of the listed bird and marine mammal species present in Grays Harbor.

The following evaluation is loosely based upon the NMFS Matrix of Pathways and Indicators (NMFS 1996), which is a set of guidelines designed to facilitate and standardize the determination of effects of projects/actions on listed anadromous salmonids. The NMFS matrix, along with a similar USFWS matrix developed for bull trout, was developed for freshwater environments and is not directly applicable to estuarine and marine waters. The following discussion is therefore organized around a set of modified pathways and indicators. Since numerical criteria for watershed functionality (e.g., between 50 and 57° F = properly functioning water temperature) are currently unavailable for estuarine and marine waters, this evaluation is qualitative rather than quantitative in nature and relies upon the professional judgement of Corps biologists in lieu of measurable physical parameters.

Information on baseline environmental conditions came primarily from two sources: studies commissioned by the Corps in 1980 as part of the impact assessment for the navigational channel widening and deepening, and a draft of the Washington State Conservation Commission's habitat limiting factors report for the Chehalis and nearby drainages (Smith and Wenger, in prep.). While the widening and deepening studies are quite old, a tremendous amount of research was undertaken at that time, so they are some of the most thorough accounts of Harbor ecology available. It is important to note that the focus of these studies was primarily on juvenile salmonids, not bull trout and coastal cutthroat. We have tried to focus the discussion on research specific to protected species, but where such information was unavailable other salmonid species are used as a surrogate. Another limitation is that much of the sampling occurred in areas that were to be impacted by deepening, not estuary-wide.

5.3 Water and Sediment Quality

In the past, water quality in Grays Harbor has been a problem which was thought to contribute to a bottleneck in Chehalis River salmon production (Smith and Wenger, in prep.). Bioassays showed that discharges from the Weyerhaeuser and ITT-Rayonier pulp mills were toxic to oyster larvae and rainbow trout. By 1990, Weyerhaeuser began to reduce their discharge of chemicals into the inner Harbor and the ITT-Rayonier mill was no longer in operation.

At present time, both the inner and outer Harbors are on Washington's 303(d) list for fecal coliform. Recent sampling in various areas of the Harbor indicate that water temperature, dissolved oxygen, and pH standards are sometimes violated, but that these problems may be the result of natural conditions (e.g., solar heating of shallow water) or nutrient enrichment attributed to wastewater treatment plant effluent.

Sediment sampling by Ecology in 1998 indicated that chemical concentrations in sediments were generally low, with a few localized problem areas (Norton 1999 as cited by Smith and Wenger, in prep.). Standards for 4-methylphenol, a degradation product of wood materials, were exceeded near the Grays Harbor Paper Mill. Concentrations of bis(2-ethyl hexyl) phthalate near Westhaven Cove were high enough to elicit concern. Of 16 other sites sampled, six violated Washington sediment standards. A summary of the results of recent Corps sediment sampling in the navigation channel can be found in the sub-section on Contaminants below.

Dredging tends to result in localized, short-term water quality degradation, particularly with respect to dissolved oxygen and turbidity. Water quality impacts are perhaps the most studied of dredging effects, and some of this research is summarized below.

Suspended Sediments

The Chehalis River has a high sediment load, which is a factor in the frequency of dredging. Kehoe (1982) found that three Chehalis sub-basins, the Wynoochee, Middle Fork Satsop, and West Fork Satsop, discharged suspended sediments at an extremely high annual rate compared to other watersheds in western Washington and Oregon. The balance of the Chehalis sub-basins contributed sediments to the system at moderate to low annual rates. For example, at the time of Kehoe's study, annual sediment discharge for the West Fork Satsop (1500 tons/mi^2/year) was *5 times* that of the highest discharge non-problem Chehalis sub-basin (the Wishkah, 300 tons/mi^2/year) and the highest discharge river in Oregon's Tillamook Basin (the East Fork Trask, 300 tons/mi^2/year). It was thought that a combination of steep topography, high rainfall, and deeply weathered surface soils make the problem sub-basins inherently susceptible to erosion and subsequent high sediment discharge levels, and that these natural conditions had been aggravated by forestry practices (Kehoe 1982).

Clamshell and hopper dredges are used to dredge the Grays Harbor channel. Elevated turbidity occurs as the bucket of a clamshell dredge impacts and withdraws from the channel bottom and is lifted through the water column to place the material in the waiting barge. Hopper dredges, which hydraulically suction material then transfer it to a hopper bin, stir up less sediments than a clamshell dredge.

Choker Research at Grays Harbor College monitored water quality during inner harbor maintenance dredging during the summer of 1990 (Phipps et al. 1992). They sampled at 34 sites, each with six stations around a clamshell dredge (two as close as possible to the dredge, two about 100 to 150 meters down-current in the plume, and two upstream of the dredge to represent ambient conditions). Three samples were taken at each station, each at different depths (top, middle, bottom) in the water column. Every effort was made to sample the worst possible conditions, such as making collections in the most turbid water as close to slack tide as possible. Water quality conditions represented by the Phipps et al. samples can therefore be considered to be more degraded than average dredging conditions for the parameters measured. Of six hundred samples, only 23 had a total suspended solids (TSS) value higher than 500 mg/l and 7 of these were measuring ambient conditions. The highest TSS measurement was 3000 mg/l (the ambient condition at this time was 700 mg/l), and most were below 1000mg/l. The higher TSS loads occurred predominantly in the lower third of the water column.

Sediments in the Grays Harbor Channel consist of coarse to medium sand, sandy silt, silt, and gravel. The coarser sediments do not remain suspended in the water column for very long. In addition, given the flushing rates calculated for Grays Harbor, sediment plumes created by both clamshell and hopper dredges are thought to dissipate rapidly. Therefore any biological effects of dredging plumes would be generally short lived. Seattle District is currently working with the Dredging Operations and Environmental Research (DOER) team at the U.S. Army Engineer Research and Development Center (ERDC) to develop a model specific to Grays Harbor that will enable us to predict the fate of dredge plumes.

When dredged material is discharged from a barge or hopper dredge, it descends through the water column as a dense, well defined fluid-like jet. As the material hits the bottom and collapses, it spreads out in all directions as a density/momentum-driven surge. The consistency and behavior of the descending jet is dependent on the characteristics of the dredged material, such as its moisture content, cohesiveness, composition (sediment size fractions), and the dredging equipment employed. All other factors being equal, the percent moisture content (PMC) of the material determines the amount of dredged material that will initially reach the bottom, the amount of time it takes to reach the bottom, the area it covers, and its tendencies for resuspension and transport. When the PMC is low, the transit time of the material is sufficiently brief that the influence of any currents in transporting the material laterally is minimal (Pequegnat 1983). Compared to hopper dredges, clamshell dredges tend to keep material relatively consolidated, which minimizes the PMC. Clamshell operations strain out most water from the sediment, while material dredged by hopper tends to retain water. Clamshell dredges are used to remove most material dredged from the Grays Harbor Navigation Channel (between 56 and 77%, depending on which type of dredge is used for Outer Crossover and South Reach).

At other sites, reported maximum concentrations of suspended sediments observed during disposal activities were less than 1,000 mg/l; the highest concentrations tend to occur in near-bottom waters, and are typically much lower (less than 200 mg/l) in mid and upper water depths (Pequegnat 1983). The Grays Harbor disposal sites are dispersive, but sediment transport away from the disposal sites would not increase turbidity any more than natural erosion and accretion processes.

Potential physiological effects of increased suspended sediment concentrations on salmonids include: biochemical stress responses (elevated plasma glucose and cortisol levels), impaired osmoregulatory capacity, gill flaring (a response to gill irritation equivalent to a cough), impaired oxygen exchange due to clogged or lacerated gills, and reduced tolerance to infection. For short-term exposures (<4 days) to sublethal concentrations (14,400 mg/l), osmoregulatory capacity is not impaired (Servizi 1990). Sockeye have been shown to exhibit gill damage at exposures of 3,100 mg/l over 96 hours (Servizi 1990). Biochemical responses and gill flaring appear to be reversible, as recovery occurs when the stressor is removed or the fish escapes the plume. However, if the stress is chronic, a metabolic cost may be incurred (Servizi 1990).

Effects of increased suspended sediment concentrations on salmonids may also include deterrence from migratory paths, and reduced foraging success. The impact of turbidity on fish foraging behavior is not clear (Gregory 1990). Some experimental work has demonstrated declines in foraging rates and reaction distances toward planktonic prey with increasing turbidity, while one study indicates that the feeding of Pacific herring larvae may be enhanced by suspended sediment concentrations as high as 1000 mg/l (Gregory 1990). Laboratory tests have also shown that some juvenile salmonids tend to swim near the surface when exposed to suspended sediments, which may make them more vulnerable to bird predation (Servizi 1990).

Laboratory experiments like those cited above have yielded some information on the response of fish to elevated suspended sediment concentrations, but applicability of this information is highly subjective given the often conflicting results attributable to variations in experimental design. For example, some mortality of chinook and coho smolts occurred over short-duration exposures to suspended sediment levels from 500 mg/l to 1,400 mg/l (Newcombe and MacDonald 1991). Yet in another experiment, concentrations up to 28,800 mg/l were shown to have had no acute effects on juvenile coho (LeGore and Des Voigne 1973).

Bioassay-type tests generally measure an endpoint, often mortality, under conditions dissimilar to those organisms encounter in the field. Dose-response relationships measured under laboratory conditions tend to simulate a worse-case scenario for motile organisms, which can often avoid unsuitable conditions (Clarke and Wilber 1999). Under most scenarios, fish and other motile organisms encounter localized suspended sediment plumes for exposure durations on a temporal scale of minutes to hours (Clarke and Wilber 1999). Testing protocols utilizing brief exposure periods and representative sediment periods would better clarify the actual hazards (Servizi 1990). A few generalizations can be taken from this research, however. Smolts are the life history stage most sensitive to elevated turbidity. For this reason, work closures in Grays Harbor were implemented to avoid dredging and disposal operations during salmonid outmigration periods. It is also clear that turbidity levels are unlikely to cause acute physiological injury to adult fish at any time during maintenance operations.

Dredging and disposal operations will degrade water quality on a very localized and temporary basis, not over the long term nor harbor-wide. The available evidence indicates that suspended sediment concentrations sufficient to cause adverse effects would be limited in extent. Adult salmonids are expected to avoid these areas readily, while juveniles would be less able to avoid such areas. Therefore, dredging would not occur during the juvenile outmigration period (April through May, or as otherwise defined by USFWS and/or WDFW). This timing restriction will reduce the potential for exposure of juveniles to adverse conditions.

Given the high fraction of suspended sediments in the Chehalis River, the baseline condition for this indicator can be considered to be at risk. The proposed project will result in localized, temporary increases in turbidity which will rapidly return to baseline conditions upon completion of maintenance operations.

Dissolved Oxygen

Dredge-induced water quality alterations are a short-term phenomena that do not cause problems in most estuarine systems. Given the relatively small quantities of sediment typically suspended, the short duration of suspension and dilution during dispersion, the suspension of sediments around dredges is not likely to lead to appreciable reductions in dissolved oxygen (Lasalle 1990). Salmonid avoidance reactions may be triggered when dissolved oxygen concentrations drop to 6 mg/l, forming an effective barrier to migratory movements (Hicks 1999, as cited by USFWS 2000).

Monitoring conducted during dredging operations by Choker Research in 1990 found that dissolved oxygen concentrations generally remained above 5 mg/l, which is the lower limit for dredging operations designated by the Washington Department of Ecology (Phipps et al. 1992; please refer to the previous section on *Suspended Sediments* for a description of this monitoring program). Measurements taken in the sediment plume 100-150 meters from the dredge were comparable to nearby ambient water concentration, and most values were above 6 mg/l. The differential between dissolved oxygen levels in the dredge plumes and ambient areas were within 1 to 2 mg/l of each other.

Under normal conditions, this indicator is not properly functioning in the inner harbor. During dredging and disposal operations, a temporary localized decrease in DO levels occurs. The Corps monitors DO levels as the dredges operate in the inner Harbor during low flow periods, and during nearshore disposal at Half Moon Bay. If DO drops below 5 mg/l, dredging operations are suspended until conditions improve. Dissolved oxygen levels return to the baseline condition soon after channel maintenance work is completed, therefore this indicator is maintained in the long term.

Contaminants

The requirements for determining the suitability of dredged material in Grays Harbor for unconfined, open-water disposal are documented in the 1995 *Dredged Material Evaluation Procedures and Disposal Site Management Manual, Grays Harbor and Willapa Bay, Washington* (the GHDMEP). The types of sediments in the four reaches of channel which are of concern because of proximity to contaminant sources are as follows: silty sand in the South Aberdeen Reach, sandy silt in the Cow Point Reach, sandy silt and sand in the Hoquiam Reach and silty sand in the North Channel (Moon Island) Reach. Coarse-grained sands found at the Bar, Entrance, and South Reaches meet no-test guidelines for high-energy areas under the Marine Protection, Research, and Sanctuaries Act.

Sampling in the year 2000 initiated the second 6-year cycle of sampling and testing that was first implemented in 1994. The Grays Harbor Navigation channel is low-ranked, meaning few or no sources of chemicals appear to contribute to channel sediments. This conclusion is based on existing data that show no or low levels of chemicals of concern and no significant toxic responses in biological tests. The GHDMEP specifies a six-year "frequency" guideline during which sampling and testing of the entire channel must be completed. For purposes of planning, alternating portions of the navigation channel are characterized every other year. Although there have been a few chemicals of concern detected in Grays Harbor sediment sampling, virtually all sediments tested have been found suitable for open water disposal since implementation of the GHDMEP in 1994.

Potential point and nonpoint sources of contaminants in Grays Harbor are associated with past and existing land uses adjacent to the estuary. Land uses are residential (housing), commercial, municipal (city outfalls and drains), industrial (paper mill, timber and wood products industries, marine vessel moorage and repair, fish processors), maricultural (oyster beds), agricultural (cranberry bogs), and recreational (parks and waterways).

One of two pulp mills that operated in the vicinity of Cow Point closed in the early 1990s. The Weyerhaeuser pulp mill, located in Aberdeen, is still in operation, but Grays Harbor Paper now occupies the facilities that once housed ITT Rayonier in Hoquiam. Grays Harbor Paper produces uncoated free sheet paper used in copying and printing.

Other potential sources of contaminants may originate from city outfalls located near the Federal Navigation channel in Aberdeen and Hoquiam. Paints, petroleum products, and antifoulants [i.e., tri-n-butyl tin (TBT)] may exist in sediments near marinas and boat docks located at Westport, the Hoquiam River in Hoquiam, the Wishkah River in Aberdeen, and smaller creeks surrounding the harbor. Boatyards (Westport Shipyard, The Boatyard and Pakonen & Son), located in Westport, Aberdeen and Hoquiam, respectively, may generate contaminants associated with marinas and sandblast grit (i.e., metals, paint chips, TBT). The GHDMEP checks for the presence of these contaminants in the standard suite of chemical tests, and TBT analysis is requested on a case-by-case basis in areas located near marinas and boatyards. Seafood processors (crabs and oysters), oyster mariculture, and cranberry processors are located in South Bay near Westport. The pesticide, sevin (carbaryl), was also routinely tested in the GHDMEP because it is used by the oyster culture industry to exterminate the burrowing shrimp that cause oysters to sink and perish.

Since 1990, the principal sources of dioxin as a result of pulp mill processing have been reduced or eliminated through Ecology actions. Dioxin concentrations are either present in low concentrations or are not detected and are no longer monitored as part of the Grays Harbor dredged material characterization process. The analysis of sevin has also been eliminated from the GHDMEP because this chemical has not been detected in Grays Harbor dredged material characterizations. Guaiacol and resin acids will continue to be monitored in Grays Harbor, considering the high volume of raw logs and wood products handled by local entities.

The most recent sampling took place in July 2000, and characterized approximately 620,000 cy from the upstream portion of the navigation channel, including Cow Point, Aberdeen and South

Aberdeen reaches. Eighty-two sediment grab samples were composited per an agency-approved sampling plan for eleven analyses. There were no exceedances of the inter-agency Dredged Material Management Program (DMMP) screening levels for any chemicals of concern, including those found in the 1998 Ecology study. Bioassays of two representative composites showed no effects. Though a suitability determination has yet to be signed by the DMMP agencies, this data indicates that all material is suitable for open-water disposal at any of the proposed disposal sites or nearshore nourishment sites.

Since these standards are designed to be protective of organisms that come into contact with sediments, concentrations and bioavailability of contaminants in sediments suspended during dredging are expected to be below levels that may cause harm to juvenile or adult salmonids.

5.4 Habitat Conditions

Substrate

Grays Harbor acts as a trap for both river and ocean transported sediments. Ocean-borne sand occurs in the outer estuary, while river-borne silts are found in the areas of river outfalls in the northern, southern, and eastern lobes of the Harbor. Wind generated waves are common in Grays Harbor and have a pronounced effect on the suspension and movement of shallow water sediments. The prevailing, and strongest, winds are from the west and south, especially during the winter. During the summer, northerly winds of less intensity frequently occur. Waves over 5 feet can occur at high tide in areas of the outer Harbor with long effective fetches, although 1 to 3 foot waves are more common. Upstream of Rennie Island, protection afforded by land masses and shorter fetch lengths limits wind generated waves to less than 2 feet.

Since sedimentation and sediment resuspension/transport are natural processes in estuaries, this indicator is considered properly functioning. Some materials dumped at the Point Chehalis and South Jetty disposal sites will be of a of a smaller size than the sands that occur there naturally. The dispersive nature of these sites will prevent the accumulation of this finer material, thereby maintaining this indicator.

Bathymetry

Numerous shallow channels have been cut into the Harbor's intertidal mudflats by ebbtide flows and discharge from the Humptulips, Elk, and Chehalis Rivers. The most distinctive are two channels along the north and south shores of the inner Harbor, which were carved by the Chehalis River. The north channel is the location of the proposed action, and has been regularly dredged since 1916. The south channel is largely untouched and much shallower. Deep-water areas occur near the mouth of the estuary, where depths of up to 80 feet are encountered.

Dredging in the entrance and bar reaches continues to affect the bathymetry of the Harbor's mouth, however this area is highly dynamic and the scale of sediment removal by dredging pales in comparison to the amount of sediment resuspended and transported by tidal currents. Bathymetry of the Harbor's entrance and outer bar was dramatically altered by construction of the North and South Jetties, which occurred from 1898 to 1910. These jetties confine tidal currents so that scouring velocities are obtained in the Harbor inlet. They were constructed to maintain a navigable channel at the mouth of the Grays Harbor, thereby reducing the need for dredging. Once the jetties were constructed, the inlet bar was forced seaward by ebb currents and the reduction of littoral drift by the South Jetty. Extensive accretion has occurred in some areas of the inlet as a result of scour in the entrance reach. The jetties have performed their intended function well, as dredging of the Harbor mouth was not need for 50 years (the entrance and bar channels were not dredged between 1941 and 1991). However, in 1990 the Bar channel was deepened to –46' MLLW as part of the Grays Harbor Navigation Improvement Project. Some dredging in the Bar, Entrance, and South Reach channels has been required since the deepening, but annual volumes of maintenance materials has been significantly decreasing and are expected to continue to decrease (USACE 1997). The Bar Channel is expected to become self-maintaining again by 2007, while dredging requirements for the Entrance Channel are expected to decrease to 110,000 cy/year by 1012.

The side slopes of the navigation channel vary throughout the Harbor. Slopes get progressively steeper towards the mouth of the Chehalis, since finer substrates are more cohesive and can therefore maintain a steeper slope. Representative slopes range from 1V:3H in the South Aberdeen, Cow Point, and Hoquiam reaches, to 1V:5H in the North, Crossover, and inner portion of the South Reach channels, to 1V:10H in the outer potion of South Reach, Entrance and Bar reaches.

Maintenance work will affect only existing channels annually disturbed by dredging, thereby maintaining this indicator.

Current Patterns

Tidal currents dominate the current regime in Grays Harbor, except in the upper estuary during periods of high Chehalis River flows. Freshwater from river runoff forms a low salinity, low density upper layer which tends to move seaward. High density currents of seawater tend to move towards the head of the estuary (or river mouth) in the lower water column. This general pattern is less pronounced in the outer harbor, where the water column is well mixed. Other spatial variations are briefly described in the following section on salinity. Flood currents are stronger along the North Jetty, while ebb tide currents dominate along the South Jetty. The mean diurnal tidal range varies from 8.5 feet at the Harbor's mouth to10.1 feet at Aberdeen.

High wind conditions can alter tidal patterns significantly; strong offshore or onshore winds affect both the magnitude and duration of tide stages. Nearshore ocean currents are also strongly influenced by tidal flows into and out of the estuary. The bathymetry off Grays Harbor refracts deep water waves towards the Harbor mouth, concentrating wave energy in the entrance and outer bar channels. Ocean swells, which most commonly approach the coast from the west-southwest or west, often pass between the North and South Jetties and enter the mouth of the estuary. Tidal flows result in significant wave transformation in the bar and entrance areas; ebb flows result in wave steepening and peaking, while the opposite occurs during flood tide.

The South Jetty and Point Chehalis disposal sites are in water much deeper than the northern portion of the entrance, so wave action has less of an effect on sediment resuspension and ebb tide (i.e., seaward) currents are strongest. Thus, most dredged material placed at these sites will enter the longshore drift system or continue seaward and be deposited in the deep water past the bar.

Current patterns in the Harbor mouth have been altered by construction of the jetties, however there is no research indicating that this change from natural conditions affects estuary biota negatively, positively, or at all. The proposed maintenance dredging will maintain current conditions for this indicator.

Salinity Gradients and Water Column Stratification

Salinities in Grays Harbor, like other estuaries, are characterized by a high degree of spatial and temporal variability. This variability is driven by meteorological conditions, river flows, and tide stage. Rivers feeding Grays Harbor have very little drainage area extending into the higher elevations of the Olympic Mountains, so river flows closely follow precipitation. Average salinity gradients vary by season and location, for example at the entrance the average is 20 ppt during the winter and 30 ppt in the summer; at Sterns Bluff 15 ppt in winter and 25 ppt in summer; at Hoquiam 5 ppt in winter and 20 ppt in summer; and at Elliot Slough 0 ppt in winter and 10 ppt in summer. Salinity is lower at low tide than at high tide and this difference increases from the Harbor entrance towards Cosmopolis, reflecting increasing influence of the Chehalis River (Loehr and Collias 1981).

Vertical salinity gradients in the Harbor are also variable, depending on tidal stage and river flow conditions. Vertical mixing is generally enhanced during periods of low freshwater flow. At the mouth of the Chehalis River, the vertical salinity profile typically displays a salt wedge below a less saline lens of fresh river water. Of four other sites surveyed, this type of profile regularly occurred only at Searns Bluff, suggesting that the predominant river flow directed through the north channel is well mixed, while marine and riverine waters in the south channel are typically well stratified (Kinney et al. 1981).

Loehr and Collias (1981) predicted that the widening and deepening of the navigation channel, which occurred a decade ago, may allow offshore upwelled oceanic waters to intrude into the Harbor to a greater degree than prior to the channel expansion. This result of such episodic intrusions would be a slight cooling of surface waters and a decrease of dissolved oxygen concentrations in the outer estuary, and increased salinities further into Harbor. The widened and deepened navigation channel is thought to accentuate salinity stratification in the inner harbor. However, no studies have been undertaken to measure such physical effects resulting from the widening and deepening project. Maintenance dredging will maintain current conditions with respect to this indicator.

Shoreline Condition and Habitat Diversity

Since the development of the Chehalis Basin's logging industry, extensive intertidal wetland acreage in the inner Harbor has been filled and/or diked. Dredged material, as well as sawdust and bark from sawmills, placed in tidelands created much of downtown Aberdeen and Hoquiam (Hiss and Knudsen 1993). The portion of the estuary between Moon Island and Cosmopolis is highly developed and industrialized; fourteen wharves, used primarily for the transport of log or wood products, are located along this area of the waterfront. Diking has been extensive in the lower Wishkah and Hoquiam Rivers, as well as near Montesano (Smith and Wenger, in prep.), and much of the shoreline along the developed portions of the inner Harbor has been hardened.

Portions of the lower Chehalis and the outer Harbor remain relatively undeveloped and likely serve as refugia for salmonids, particularly juveniles. Between RM 1 (east of Aberdeen) and RM 11 (just west of the Wynoochee River), there is a large floodplain complex with numerous sloughs under strong tidal influence and well buffered by older conifers and hardwoods (Ralph et al. 1994 as cited by Smith and Wenger, in prep.). Significant shoreline acreage along the outer Harbor remains undeveloped. A narrow, fringing band of estuarine emergent vegetation is present along much of this shoreline. In a few areas, such as Oyehut, Bowerman Basin, and eastern Westport, rather extensive marsh stands occur.

Large woody debris (LWD) was more common in the estuary prior to logging, where it provided cover for juvenile salmonids and a firm substrate for macroalgal production. The areal extent and density of Grays Harbor's eelgrass beds may change from year to year as old beds are uprooted and new ones established. Long-term trends in the extent of eelgrass beds have not been monitored, however.

Habitat diversity can be classified as not properly functioning in the inner Harbor, and properly functioning in the outer Harbor. The proposed dredging will not alter the types, quantity, or quality of habitats currently available in Grays Harbor. This work will maintain current conditions in the estuary. Since the widening and deepening of the navigation channel a decade ago, maintenance work similar to that proposed here has occurred on an annual basis.

5.5 Biota

Salmonids utilize distinctly divergent prey species in Grays Harbor and their diets are typically associated with the predominant epibenthic or neritic habitats in which they are found. Juveniles occupying nearshore habitats feed predominately upon epibenthic crustaceans, primarily harpacticoid copepods, cumaceans, and gammarid amphipods. Salmonids in deeper neritic habitats tend to be somewhat larger and feed upon more pelagic prey such as larval fish (particularly northern anchovy) and adult insects. As a general rule, juvenile salmonids feed upon epibenthic crustaceans upon their initial entry into the estuary and upon some growth convert to neritic zooplankton (Buechner et al. 1981).

Primary Producers
Among the estuary's primary producers, eelgrass (*Zostera* spp.) represents the greatest source of organic carbon, followed by benthic algae, marsh vascular plants, and phytoplankton (Thom 1981). Relative contributions of organic carbon to the estuary vary spatially and temporally. Eelgrass and sediment-associated microalgal production is more important in regions with broad tidal flats, while macroalgal production is greatest in areas where hard substrata (e.g., logs, roots, cobble) exists in the intertidal zone. In the spring and summer benthic and planktonic are the primary carbon sources, while autumn vascular plant die-offs results in the primary input of particulate organic carbon to the estuary during early winter.

The growth of primary producers may be suppressed by light attenuation resulting from the elevated suspended sediment concentrations associated with dredging and disposal operations. Water quality monitoring during Grays Harbor maintenance dredging has indicated that substantial increases in turbidity are generally limited to a radius of about 150 feet around the dredge (Thom 1981). This area is very small compared to the total area in the estuary occupied by primary producers, therefore there is probably no appreciable change in primary productivity throughout the estuary caused by working dredges (Thom 1981). Dredged material disposal operations likely impact primary productivity in the immediate area of the disposal site. Given the dominant tidal currents at these sites, disposal plumes will generally move seaward. However, under some tidal and weather conditions a plume of finer sediment fractions may travel over shallow mudflat areas in North Bay (Thom 1981). Such an increase is likely not measurable compared to the relative contribution of suspended sediments from the Humptulips Basin.

Increased turbidity resulting from maintenance operations is not expected to significantly affect phytoplankton productivity in the estuary for a couple of reasons. The portion of sediment plumes resulting in the greatest turbidity increase would be located in near-bottom waters. Phytoplankton production typically occurs in the upper portion of the water column where increases in turbidity are expected to be minimal. Turbidity plumes at the surface would be highly localized, likely no more than 2,000 feet from the dredging vessel. As dredging operations progress along the channel, so would the turbidity plume. Following completion of dredging activities at a specific location, the turbidity plume would settle within a few days. Any reduction in phytoplankton productivity resulting from project-related turbidity would be expected to return to pre-project conditions within days. The estuary is highly dynamic and constantly flushed with oceanic waters bringing in new plankton populations. Phytoplankton have rapid replication times, so that populations can double in a day; they can generally mature to reproductive life stages within 3 days and can remain viable for days to weeks (Little 2000).

The areal extent and density of Grays Harbor's eelgrass beds may change from year to year as old beds are uprooted and new ones established. Long-term trends in the extent of eelgrass beds have not been monitored, however. No eelgrass or benthic algae will be directly removed or buried by dredging or disposal operations, but water clarity is thought to be a limiting factor for eelgrass in Grays Harbor. Light attenuation limits the depth to which *Zostera* spp. can grow by impeding photosynthesis. Seagrass populations can survive increased turbidity for short periods of time, but prolonged increases in light attenuation result in loss or damage of the population. Five of the ten reaches of the navigation channel, Hoquium, North Channel, Inner Crossover, Outer Crossover, and South Reach, are adjacent to broad, shallow mudflat areas where eelgrass has historically been present. These reaches are dredged during much of the growing period (April, May, and mid-July through mid-February). The extent to which dredging affects eelgrass beds in these areas is unknown.

Little research on the estuary's primary productivity or eelgrass monitoring has occurred since Thom's work, so it is not clear if the baseline condition is properly functioning. Yearly dredging of the navigation channel has occurred for decades, so current baseline conditions reflect any adverse impact that occurs. Therefore, the proposed work will maintain baseline conditions.

Epibenthic and Benthic Invertebrates

Cordell and Simenstad (1981) sampled shallow sublittoral and lower littoral (defined as -16' to 0' MLLW and 0' to +6.5' MLLW, respectively) epibenthic communities at Moon Island in the inner harbor. Prominent taxa included harpacticoid and calanoid copepod larvae, adult harpacticoid copepods, as well as barnacle and polychaete larvae. The stomach contents of juvenile chum and chinook captured at this site as part of an associated study (Prinslow et al. 1981) indicated that harpacticoid copepods and cumaceans are important prey resources for these fishes. There was some indication from these studies that epibenthic-feeding juvenile salmonids appeared to be selecting sparsely distributed prey. This suggests that shallow sublittoral habitat may be important in determining the number of juvenile salmonids which can efficiently obtain enough food in the upper estuary, where the extent of this habitat type is small relative to the outer harbor (Cordell and Simenstad 1981). The areas impacted by the proposed work would be deeper channel habitat. No previously undisturbed areas will be impacted by the maintenance operations.

The benthic fauna of the Grays Harbor navigation channel are subjected to frequent disturbance and stress—both natural and anthropogenic—including frequent dredging, shipping activity, salinity fluctuations, large-scale sediment movements, and wave action. Turbidity associated with dredging may interfere with feeding and respiratory mechanisms of benthic organisms. Several of the species characteristic of the channel are opportunistic species, often small, tube-dwelling, surface-deposit feeders that exihibit patchy distribution patterns in space and time (Albright and Bouthillette 1982).

Several studies have found that benthic organisms recolonize dredged sites quickly, often reaching similar densities within eighteen months, but that they may never reach mature equilibrium benthic communities. In 1992 the Seattle District contracted a study on dredged material management in Grays Harbor and Willapa Bay which included a benthic infauna community analysis (SAIC 1993). In this study various samples were taken of areas that had been previously dredged and areas that had not been dredged. There were more deeply burrowing organisms obtained in the non-dredge sites than in the dredged sites, indicative of a more mature benthic community. The dredged sites consisted of more opportunistic benthic species, as opposed to a mature community.

The disposal sites are characterized by a high rate of natural disturbance, given the high velocity tidal currents, exposure to strong wind and wave action, and large volumes of sediments eroded and deposited in the area. Significant epibenthic or infaunal prey resources would not occur at these relatively deep water sites.

The baseline condition for in-channel benthic invertebrates is highly modified from natural conditions. There is insufficient information available to determine if the baseline condition for this indicator in the remainder of the Harbor is functioning properly. In areas other than the navigation channel, this indicator may be temporarily degraded by turbidity associated with dredging and disposal operations, but will rapidly return to baseline conditions upon completion of the maintenance work.

Neritic Zooplankton

Studies conducted by Kinney et al. (1981) found that Grays Harbor's prominent taxa, based on numerical frequency of occurrence in their bongo net frame collections, included barnacle larvae (nauplii and cyprides), the calanoid copepods *Eurytemora americana, Acartia clausi,* and *Calanus* spp., and the crangonid shrimp larvae *Centropages abdominalis*. Juvenile and adult sand shrimp (*Crangon francisscorum*), the mysid shrimp *Neomysis mercedis*, and *Eurytemora americana* composed the majority of the total standing crop (biomass).

In an associated study, Prinslow et al. (1981) sampled juvenile salmonids to document their spatial and temporal movements through Grays Harbor. The predominant prey of juvenile coho collected by these beach and purse seines were neritic zoea and megalop larvae of *Cancer* spp. A small number of cutthroat trout were collected during this study, and crab larvae were also their primary prey with juvenile smelt their secondary prey. Kinney et al. (1981) therefore determined that juvenile salmonids prey upon only a small fraction of the neritic zooplankton produced or transported into Grays Harbor. Those organisms utilized as prey tended to be rare and large, although avoidance of sampling nets by these large zooplankters may have negatively biased actual abundance and availability to foraging salmonids.

While the impacts of dredging and disposal on benthic communities are relatively well studied and understood, impacts on zooplankton have been studied less and are poorly understood. This lack of research is partly due the technical difficulties (representative sampling, need for *in situ* work, the subtlety of anticipated effects, and the differentiation of those effects from other anthropogenic effects) associated with studying this type of impact (Segar 1990). Crustaceans, while not often focus on the suspended sediment tolerances bioassay studies, have been shown to tolerate high suspended sediment concentrations (up to 10,000 mg/l) for durations on the order of two weeks (Clarke and Wilber 1999). Laboratory studies reviewed by Clarke and Wilber (1999) indicate that crustaceans do not exhibit detrimental responses at dosages within the realm of suspended sediment conditions associated with dredging projects.

While Dungeness crab mortality rates are affected by dredging (primarily entrainment of adult crabs), mitigative measures have prevented an overall populations decline. Therefore, with respect to this prey item, there has been a discountable reduction in prey availability attributable to yearly dredging operations. Navigation dredging in Grays Harbor entrains and kills a small percentage of the estuarine population of Dungeness crabs. Studies on dredging impacts to crab have shown that impacts to crab vary with season, age and size of crab, location and dredging method. A crab mitigation plan presented in the 1989 EISS used timing and dredge type to minimize impacts to crab, and described a process for mitigating for lost crabs by using intertidal oyster shell to serve as habitat for newly-settled crab. That mitigation agreement was updated in 1998 by consensus of an interagency group. The updated plan includes some replacement of hopper dredging by clamshell dredging (clamshell dredges entrain only a small percentage of those entrained by hopper dredges) and acceptance of a new model for evaluating mitigation production on oyster shell plots. Population studies continue and could contribute to new timing goals for the outermost reaches of the navigation channel, where crab impacts are greatest.

Despite the clear facts that dredging causes crab mortalities, and that oyster shell mitigation produces crab, neither of these impacts can be detected in crab population surveys or commercial landings over time. The natural forces governing crab abundance vary so widely that dredging impacts are not detectable at a population level. Some of these natural forces include El Nino/La Nina cycles; ocean currents that can carry larvae on- or off-shore, and cyclical population trends.

There is insufficient information available to determine if the baseline condition for this indicator is functioning properly. This indicator may be temporarily degraded by turbidity associated with dredging and disposal operations, but will likely return to baseline conditions upon completion of the maintenance work.

Forage Fish

Forage fish are an important and abundant fish species in Washington, significant due to the critical part they play as the prey base for a large variety of other marine organisms. Simenstad (1981) found seven species of forage fish to occur in Grays Harbor: Pacific herring (*Clupea harengus pallasi*), Pacific sand lance (*Ammodytes hexapterus*), northern anchovy (*Engraulis mordax*), surf smelt (*Hypomesus pretiosus*), longfin smelt (*Spirinchus thaleichthys*), whitebait smelt (*Allosmerus elongatus*), and American shad (*Alosa sapidissima*). Northern anchovy were the most ubiquitously distributed species and were represented in all life history stages. Surf smelt were the most common species in the lower estuary, while longfin smelt appeared to be restricted to the upper reaches of the estuary. Juvenile Pacific herring were also abundant.

Simenstad (1981) found the occurrence of forage fish in Grays Harbor to be highly transitory and typically related to influxes of fish into the estuary from offshore sources. The residence time of forage fish appeared to be somewhat dependent upon physical processes (e.g. passive transport via intrusion of oceanic water masses into the Harbor due to coastal upwelling). Only adult and juvenile northern anchovy, juvenile Pacific herring, and juvenile longfin smelt were consistently abundant over Simenstad's sampling period.

Most forage fish species are expected to avoid the dredging and disposal areas. However, McGraw and Armstrong (1990) found that Pacific sand lance do get entrained by hopper dredges at a rate of 594 fish per 1000 cy dredged. There is insufficient information available to determine if this mortality rate has a significant affect on the population dynamics of sand lance in Grays Harbor. Most other species are thought to actively avoid the dredges, or occur in nearshore areas out of the immediate vicinity of the dredges. Dredging activities are not expected to have an effect on the spawning of the forage fish community. Shallow areas created by bottom dump barge placement of dredged material in Half Moon Bay provide good foraging habitat for sand lance, herring, and surf smelt (Burkle 2000).

There is insufficient information available to determine if the baseline condition for this indicator is functioning properly. Conditions for most forage fish species may be temporarily degraded by turbidity associated with dredging and disposal operations, but will likely return to baseline conditions upon completion of the maintenance work. The exception is sand lance, which are entrained by hopper dredges. On average, up to 625,000 sand lance may be killed each year, depending on whether or not hopper dredges are used in the Outer Crossover and South Reaches, as well as the abundance and distribution of sand lance during hopper dredge use. The effect of reduced numbers of this prey species on salmonids are unknown.

Exotic Species

There is currently a great effort underway by the Washington State Departments of Agriculture and Fish & Wildlife to prevent the spread of the invasive marsh cordgrass *Spartina alterniflora* into Grays Harbor and neighboring Willapa Bay. *Spartina* forms thick clumps that trap sediments and converts tideflats into wet meadows, often displacing eelgrass (*Zostera spp.*). Although *Spartina* was introduced in Willapa Bay about 100 years ago, it was not documented in Grays Harbor until 1992. Since this time, *Spartina* has been documented and eradicated at several sites in Grays Harbor, including Grass Creek, Bowerman Basin, the Johns River estuary, Damon Point, near the Westport Coast Guard Station, Grass Island, Bottle Beach, Pirates Cove, and the Elk River estuary (Smith and Wenger, in prep.).

Since 1997, some specimens of the non-indigenous green crab (*Carcinus maenas)* have been found in Grays Harbor. However, there are indications that the spread of the crab in the estuary, at least for the present, is being kept in check by natural forces. Green crab have only been found in the upper intertidal area of the estuary among marshy vegetation. It is thought that native crab species are able to out-compete green crabs in mudflat, oyster bed, and channel habitats. No green crab have been found on the mitigation plots or in limited surveys of oyster beds in Grays Harbor.

This indicator can be considered at risk. The proposed action will maintain this indicator.

Predation

Potential predators of salmonids in Grays Harbor include marine mammals (primarily pinnipeds), birds, and northern pike minnow (*Ptychocheilus oregonensis*) (Smith and Wenger, in prep.). It has been suggested that poor environmental conditions (e.g. water quality and riparian habitat) in the lower Chehalis and inner Harbor could increase salmonid susceptibility to avian predators (Schroder and Fresh 1992, as cited by Smith and Wenger, in prep.). However, there is little information available to estimate salmonid mortality attributable to predation by birds, so potential population-level impacts are unknown. Northern pike minnow are abundant in the Chehalis, but are not thought to account for unusually high levels of salmonid mortality (Schroder and Fresh 1992, as cited by Smith and Wenger, in prep.). In one study, salmon smolts were found in only 3.5% of stomachs sampled and high predation rates were associated with the release of hatchery fish (Schroder and Fresh 1992, as cited by Smith and Wenger, in prep.).

For most sites where pinniped and salmonid populations co-occur, NMFS (1997) found there is insufficient information to determine whether the pinnipeds are currently having a significant impact on the salmonid populations. However, pinniped predation has been documented to have a significant impact on salmonid populations where there is a high local abundance of marine mammals coincident with salmonid migrations, restricted passage, and depressed salmonid populations (NMFS and WDFW 1995). Smith and Wenger (in prep.) note that two of these conditions exists in Grays Harbor: marine mammal populations have been increasing and some salmon stocks are considered to be depressed.

According to NMFS (1997), in Grays Harbor there is a potential for harbor seal predation on adult and juvenile salmonids from May to July and December to February. To the extent that dredging activities in the relatively confined lower Chehalis slow the migration of juvenile or adult salmonids, predation levels may increase slightly during dredging operations.

This indicator can be considered at risk. The proposed action may degrade this indicator during dredging operations. Such degradation would be temporary and highly localized, and there is insufficient information available to determine potential impacts on salmonid populations. Through timing restrictions on inner Harbor and lower Chehalis dredging, potential dredging-induced predation effects on listed and proposed salmonids would be discountable.

Entrainment

Mobile epibenthic organisms and demersal fish are sometimes entrained, or suctioned along with the sediment slurry, by hopper dredges. In a review of ten years (1979-1989) of entrainment data from Grays Harbor, McGraw and Armstrong (1990) found twenty-eight species of fish to be identified in entrainment samples. Pacific sand lance (*Ammodytes hexapterus*) were entrained at the highest rate (594 per 1000 cy, please see the discussion in the Forage Fish section above), followed by Pacific staghorn sculpin (*Leptocottus armatus*, 92 per 1000 cy) and Pacific sanddab (*Citarichthys sordidus*, 76 per 1000 cy). The greatest entrainment rates and number of species occurred in the South Reach; for much of the study period, hopper and pipeline dredges were used in the inner harbor. A comparison of trawl data with this entrainment data indicates that larger crabs and some fish actively avoided the dredges. The only salmonid in this data set was one chum salmon fry (*O. keta*) entrained by a pipeline dredge in February of 1981.

Clamshell dredges are currently used to remove between 56 and 77% of the material dredged from the Grays Harbor Navigation Channel; annual percentages depend on the type of dredge is used for Outer Crossover and South Reach. Given the characteristics of this equipment, it is generally accepted that clamshell dredges do not entrain fish. Clamshell buckets remains open until impacting the bottom, so the bucket cannot trap a mobile organism during its descent.

The type of equipment used for the majority of maintenance dredging in Grays Harbor, combined with timing restrictions, reduce the potential for salmonid entrainment to discountable levels.

6. DETERMINATION SUMMARY

Below is a table summarizing the status and effect determinations made for each of the species potentially occuring in the project vicinity. Also included are the page numbers where detailed descriptions of the forecasted effects of the proposed action on these species can be found.

Table 2. Determination Summary Table

Species	Listing Status	Effect Determination	Page
Bald Eagle	Listed Threatened	Not likely to adversely affect	25
Brown Pelican	Listed Endangered	Not likely to adversely affect	27
Western Snowy Plover	Listed Threatened	Not likely to adversely affect	28
Aleutian Canada Goose	Listed Threatened	Not likely to adversely affect	30
Marbled Murrelet	Listed Threatened	Not likely to adversely affect	31
Bull Trout	Listed Threatened	Not likely to adversely affect	32
Coastal Cutthroat Trout	Proposed	Not likely to jeopardize the continued existence	35
Humpback Whale	Listed Endangered	Not likely to adversely affect	36
Steller Sea Lion	Listed Threatened	Not likely to adversely affect	38
Coho	Candidate	No Determination Made	39
Blue Whale	Listed Endangered	No Effect	8
Fin Whale	Listed Endangered	No Effect	8
Sei Whale	Listed Endangered	No Effect	8
Sperm Whale	Listed Endangered	No Effect	8
Leatherback Sea Turtle	Listed Endangered	No Effect	8
Loggerhead Sea Turtle	Listed Threatened	No Effect	8
Green Sea Turtle	Listed Threatened	No Effect	9
Olive Ridley Sea Turtle	Listed Threatened	No Effect	9

7. EVALUATION OF EFFECTS ON PROTECTED SPECIES

7.6 Bald Eagle

The Washington State bald eagle population was listed as threatened under the Endangered Species Act of 1973, as amended (64 FR 16397), in February 1978. Since DDT was banned in 1972, bald eagle populations have rebounded. The bald eagle was proposed for de-listing in July 1999.

The bald eagle is found only in North America and ranges over much of the continent, from the northern reaches of Alaska and Canada to northern Mexico. Bald eagles in Washington State are most commonly found along lakes, rivers, marshes, or other wetland areas west of the Cascades, with an occasional occurrence along major rivers in eastern Washington.

Bald eagles nest between early January and mid-August. The characteristic features of bald eagle breeding habitat are nest sites, perch trees, and available prey. Bald eagles primarily nest in uneven-aged, multi-storied stands with old-growth components. Factors such as tree height, diameter, tree species, position on the surrounding topography, distance from water, and distance from disturbance also influence nest selection. Bald eagles normally lay two to three eggs once a year, which hatch after about 35 days. Snags, trees with exposed lateral branches, or trees with dead tops are often present in nesting territories and are critical to eagle perching, movement to and from the nest, and as points of defense of their territory.

The bald eagle wintering season extends from October 31 through March 31. Food is recognized as the essential habitat requirement affecting winter numbers and distribution of bald eagles. Other wintering habitat considerations are communal night roosts and perches. Generally the largest, tallest, and more decadent stands of trees on slopes with northerly exposures are used for roosting; eagles tend to roost in older trees with broken crowns and open branching (WDFW 1998). Bald eagles select perches on the basis of exposure, and proximity to food sources. Trees are preferred over other types of perches, which may include pilings, fence posts, powerline poles, the ground, rock outcrops, and logs (Steenhof 1978).

Known Occurrences in the Project Vicinity

Bald eagle sightings during the winter months are more frequent than during other times of the year, as Grays Harbor provides important bald eagle winter feeding habitat. Anadromous fish returning to spawn, waterfowl, and shorebirds are the primary prey items in the estuary. Eagles tend to congregate near the mouths of the Humptulips, Elk, Johns, and Hoquiam rivers, and near Newskah and Charley creeks. Bald eagles likely prey on the shorebirds and waterfowl that congregate in the Oyhut Wildlife Recreation Area and on Damon Point, which are located near the northern mouth of the harbor.

A query of the Washington Department of Fish and Wildlife Priority Habitats and Species database and the Washington Department of Natural Resources Wildlife Heritage Points database indicated that 17 bald eagle nests are located near the shores of the Harbor and the lower Chehalis River. The nest closest to the navigation channel is near the north shore of the Harbor east of Point New, approximately 1 mile north of the navigation channel.

Effects of the Action

Dredging and disposal operations would extend throughout the course of 5 years, so activities would occur during both the bald eagle wintering and nesting seasons. However, various reaches will be dredged during different times of the year. The bald eagle nest closest to the navigation channel is approximately 5000 feet away from the area where dredging is to occur, so the likelihood that the noise associated with maintenance operations would disrupt eagle nesting and rearing of young is discountable (USFWS 1999). In addition, dredging in the nearest reaches will occur from August through February, so only the last 15 days of nesting season will overlap with dredging in the North Channel and Crossover reaches.

No communal night roosts or perch trees would be physically disturbed by dredging activities. Foraging bald eagles may be displaced by the noise of heavy equipment, but dredging will not occur near any preferred foraging areas nor will the availability of prey will be significantly disrupted by project construction. Any eagles in the area would be somewhat accustomed to high levels of human activity in and near the channel. Eagles tend to tolerate more disturbance at feeding sites than in roosting areas (Steenhof 1978).

Determination of Effect

The Corps believes this project **is not likely to adversely affect** the bald eagle. This determination is based on the lack of nests and communal night roosts in the immediate vicinity of the navigation channel. This project would have no effects on bald eagle foraging, nesting, or roosting habitat. While dredging activities have the potential to temporarily disrupt feeding opportunities in a localized area, this project would not alter the long-term food base.

7.7 Brown Pelican

In 1970 the brown pelican was listed as an endangered species under Endangered Species Conservation Act of 1969. This species is currently listed as endangered under the Endangered Species Act of 1973, as amended.

The California brown pelican is the Pacific coast form of a more widespread species. The breeding distribution of the subspecies ranges from southern California southward to Mexico. Between breeding seasons, the subspecies may range as far north as Vancouver Island (Gress and Anderson 1983). Post-breeding dispersal patterns depend largely on oceanographic conditions which influence prey availability. During the summer, brown pelicans migrate northward from their breeding range in central California to feed. The primary northward movement occurs in July, however the migration is "irregular and prolonged" (Bent 1964). They return south in the spring for nesting season, though juveniles may remain in the northern feeding grounds for several weeks after the adults have left. Peak egg laying generally occurs in March and April.

Pelicans eat fish species generally considered unimportant commercially, such as menhaden, herring, sheepshead, pigfish, mullet, grass minnows, top minnows silversides, and occasionally prawns. Feeding occurs primarily in shallow estuarine waters with the birds seldom venturing more than 20 miles out to sea except to take advantage of especially good fishing conditions. Sand spits, offshore sand bars, and rock areas such as jetties are used extensively as daily loafing and/or nocturnal roost areas.

In the late 19th and early 20th centuries, pelicans were hunted for their feathers, which were used to adorn women's clothing and hats. Following World War I, fishermen believed pelicans were decimating catches and slaughtered the birds by the thousands. During the late 1960s and early 1970s, the west coast brown pelican population experienced widespread pollutant-related reproductive failures. Since DDT was banned in 1972, pelicans have made a steady comeback. Brown pelicans are sensitive to human disturbance during some stages of their life cycle. The greatest impact occurs during the early stages of breeding (Gress and Anderson 1983).

Known Occurrences in the Project Vicinity

The brown pelican may be present in Grays Harbor from June through March, when they are commonly seen flying along the shore. They have been noted feeding in Half Moon Bay and in the vicinity of the South Jetty during September. Pelicans tend to favor rocky shorelines for perching. The nearest brown pelican nocturnal roost area is located in Willapa Bay.

Effects of the Action

Brown pelicans will be in California nesting for a portion of year, and these months correspond to the most sensitive portion of the pelican life cycle. During the remaining months, they can be expected to feed in the area. Noise associated with dredging and disposal operations may result in localized, temporary disruptions to foraging in areas near the navigation channel. It is thought that effects of disturbance on non-breeding pelicans are not as significant as effects of similar disturbances during the breeding season. Pelicans are thought to be more flexible in their response to disturbance when not breeding, since they are not held to a relatively limited geographic area as they are during the breeding season (Gress and Anderson 1983). No perching spots or night roost areas would be affected by dredging and disposal activities.

Since brown pelicans forage by sight, any increases in turbidity could result in reduced foraging success in the vicinity of dredging operations. Prey items may experience a parallel reduction in the visibility of prey, and are expected to avoid any turbidity plumes. Brown pelicans are a highly mobile species that range over large areas to forage. Any reduction in availability of food would be highly localized and would subside rapidly upon completion of the dredging and disposal operations. As discussed in Section 5, dredging and disposal operations are not expected to result in a long-term reduction in the abundance and distribution of forage fish. In fact, the shallow areas created by bottom dump barge placement of dredged material in Half Moon Bay provide good foraging habitat for sand lance, herring, and surf smelt (Burkle 2000). Large flocks of brown pelicans have been seen feeding in this area.

Determination of Effect

The proposed project is **not likely to adversely affect** the brown pelican since potential effects would occur during the non-breeding season and would be relatively localized in relation to this species' foraging range. In addition, pelicans are accustomed to human activity in the area, and there is ample feeding habitat available elsewhere in Grays Harbor.

7.8 Western Snowy Plover

The western snowy plover was listed as a threatened species under the Endangered Species Act of 1973, as amended in March 1993. The primary cause of the western snowy plover population decline is poor reproductive success resulting from loss of nesting habitat. Active nesting colonies have declined as a result of the spread of non-native European beachgrass, urban development, human disturbance, predation, and inclement weather.

The western snowy plover breeds on the Pacific coast from southern Washington to Mexico, with a center of distribution near the southern boundary of California. Preferred nesting habitat includes sand spits, dune-backed beaches, unvegetated beach strands, open areas around estuaries, and beaches at river mouths (USFWS 1993). Most snowy plovers return to the same breeding site in subsequent breeding seasons. Of 28 snowy plover breeding sites on the Pacific coast two occur in Washington, one at Leadbetter Point in Willapa Bay and another at Damon Point in Grays Harbor. In December 1999, the USFWS designated both nesting sites as Western snowy plover critical habitat (USFWS 1999). Damon Point is located approximately 9000 feet north of Entrance Reach and the South Jetty disposal site.

The breeding season of the western snowy plover extends from mid-March through mid-September. In Washington clutches are initiated from late April to late June, chicks hatch one month after eggs are laid, and fledging occurs from late June through August (WDFW 1995). Chicks leave the nest hours after hatching, and rarely remain in the nesting territory until fledging. Nest success varies widely. Instances of low nest success have been attributed to a variety of factors, such as predation, human disturbance, and inclement weather conditions.

Some birds winter in the same areas used for breeding, while others migrate either north or south to wintering areas. Snowy plovers occasionally winter in southern coastal Washington, however most winter south of Bodega Bay, California. Wintering habitats are similar to those used in during the nesting season.

Snowy plovers forage on invertebrates in the wet sand and surf-cast macroalgae of the intertidal zone, in sandy areas above high tide, on salt pans, on spoil sites, and along the edges of salt marshes and salt ponds.

Known Occurrences in the Project Vicinity

When plovers are in the area during nesting season, they generally forage on natural dunes along the ocean beaches and on ephemeral sand spits within the Oyhut Wildlife area (Richardson 1999). Plovers nest on recently accreted, unvegetated areas of Damon Point. Up to six adults and four nests were found in a 1994 survey at Damon Point and Oyhut Wildlife Area (WDFW 1995). Vegetation density is likely a limiting factor for nest site placement on Damon Point; only when accretion outpaces pioneering vegetation, is there a net gain of potential plover nesting habitat (WDFW 1995). Damon Point State Park and the Oyhut Wildlife Area, which borders the Ocean Shores sewage treatment facility, have been designated as critical habitat for the Western snowy plover.

The northernmost record of wintering snowy plovers on the Pacific coast was on Cape Shoalwater on the northern mouth of Willapa Bay (USFWS 1995). Plovers are not known to over-winter on Damon Point or within the Oyhut Wildlife Area (USFWS 1999).

Effects of the Action

The proposed work would have no effect on the snowy plover food base. No physical impacts of the proposed work on recent plover nesting areas are anticipated as all of the work would be at least 9000 feet from recent nesting areas, although sediment dynamics in the outer Harbor are not entirely understood. Construction noise will not likely travel to Damon Point, so potential effects to nesting behavior are improbable. The proposed project will have no effect on plover predator populations.

Determination of Effect

The proposed project is **not likely to adversely affect** the western snowy plover since effects to plover foraging or nesting habitat are not anticipated. Potential noise disturbance effects are expected to be insignificant. The Corps has determined that the proposed project will **not adversely modify** designated Western snowy plover critical habitat, as dredging and disposal operations are not likely to alter the topography or hydrology of Damon Point.

7.9 Aleutian Canada Goose

The Aleutian Canadian goose was federally recognized as an endangered species in 1967, and was reclassified as a threatened species under the Endangered Species Act of 1973, as amended in December 1990. The Aleutian Canadian goose was proposed for de-listing in August 1999.

The Aleutian Canadian goose is one of 11 currently-recognized subspecies of the large and diverse *Branta canadensis* group. It is the only subspecies in this group whose range once included both the North American and Asian continents. The Aleutian Canadian goose is currently nests on remote islands southward of the Alaska Peninsula and in the Aleutian Archipelago (USFWS 1990). Most Aleutian geese migrate from their Alaskan breeding grounds in September. They may stop along the Washington and Oregon coasts en route to wintering grounds in California, where they begin arriving in mid-October. The California winter habitat is primarily agricultural lands, where the geese feed on grass, waste beans, and grains such as corn and sprouting winter wheat (USFWS 1999). Aleutian geese depart wintering areas in April, and return to Alaska to nest and rear young between May and September.

The decline in numbers of Aleutian geese is attributed to predation by arctic foxes, which were introduced on nesting grounds from 1836-1930. Hunting during migratory periods and on wintering areas is thought to have kept their numbers depressed (USFWS 1999). In addition, development and modification of wintering and migration habitat is considered a threat to Aleutian geese populations (USFWS 1999).

Known Occurrences in the Project Vicinity

Although Washington was potentially part of the historical winter range of the Aleutian Canada goose, today the state is considered important only for its migratory habitat. The Willapa National Wildlife Refuge and surrounding fields/farms provide the principal stop-over habitat in Washington. Occasionally individuals and small flocks stop briefly in other parts of the state, such as the Ridgefield National Wildlife Refuge. No other regularly-used areas are known (Hays 1997).

Birds usually visit Willapa Bay during the fall migration, from September until the end of November, whereas sightings of spring migrants generally occur between February and March (Hays 1997).

Effects of the Action

The proposed project would have no effect on Aleutian goose nesting or wintering habitat. No known stop-over sites in the vicinity of the project. However, the noise of heavy equipment could disrupt Aleutian goose flight paths; such an effect would likely be insignificant.

Determination of Effect

The proposed project is **not likely to adversely affect** the Aleutian Canadian goose since the proposed work will have no effect on nesting, wintering, or stop-over habitat. Potential effects of any disruptions to flight paths would be discountable.

7.10 Marbled Murrelet

The marbled murrelet was listed as a threatened species under the Endangered Species Act of 1973, as amended in October 1992. Primary causes of population decline include the loss of nesting habitat, and direct mortality from gillnet fisheries and oil spills.

The subspecies occurring in North America ranges from Alaska's Aleutian Archipelago to central California. Marbled murrelets forage in the near-shore marine environment and nest in inland old-growth coniferous forests of at least seven acres in size. Marbled murrelets nest in low-elevation forests with multi-layered canopies; they select large trees with horizontal branches of at least seven inches in diameter and heavy moss growth. Of 95 murrelet nests in North America during 1995, nine were located in Washington. April 1 through September 15 is considered nesting season; however in Washington, marbled murrelets generally nest between May 26 and August 27 (USFWS 1999). Adults feeding young fly between terrestrial nest sites and ocean feeding areas primarily during the dawn and dusk hours.

Marbled murrelets spend most of their lives in the marine environment, where they forage in areas 0.3 to 2 km from shore. Murrelets often aggregate near localized food sources, resulting in a clumped distribution. Prey species include herring, sand lance, anchovy, osmerids, seaperch, sardines, rockfish, capelin, smelt, as well as euphasiids, mysids, and gammarid amphipods. Marbled murrelets also aggregate, loaf, preen, and exihibit wing-stretching behaviors on the water.

Although marine habitat is critical to marbled murrelet survival, USFWS' primary concern with respect to declining marbled murrelet populations is loss of terrestrial nesting habitat. In the marine environment, USFWS is primarily concerned with direct mortality from gillnets and spills of oil and other pollutants (USFWS 1996).

Known Occurrences in the Project Vicinity

Marine observations of murrelets during the nesting season generally correspond to the presence of large blocks of nesting habitat. Studies have found that during the nesting season murrelets are more numerous along Washington's northern coast and less abundant along the southern coast. This distribution appears to be correlated with proximity to old growth forest, the distribution of rocky shoreline versus sandy shoreline, and the abundance of kelp and prey items (USFWS 1996). Murrelets, therefore, would not be expected to forage regularly in the project vicinity during the nesting season. Observations documented by Speich and Wahl (1995) support this conclusion. They found that marbled murrelets are generally present in Grays Harbor during the fall, winter, and spring; they are rarely seen in August and September. The highest numbers occurred in habitats closer to shore, generally in the Grays Harbor channel out to the 50m depth contour. No designated critical habitat is located in or along the shores of Grays Harbor.

Effects of the Action

Construction activities would have no effect on murrelet nests, nesting habitat, or nesting season foraging behaviors. However, construction activities would occur in and adjacent to foraging habitat. The navigation channel and vicinity are the areas where murrelets are commonly seen when in the Harbor (Speich and Wahl 1995). Therefore, during non-nesting periods, some disturbance to prey items and foraging behaviors could be expected.

Noise levels are a concern, as dredging and disposal operations will produce noise above ambient levels. The effects of human disturbance on murrelets at sea is not well documented, but they apparently habituate to heavy levels of boat traffic (Strachan et al. 1995). USFWS guidance suggests that noise above ambient levels is considered to potentially disturb marbled murrelets when it occurs within 0.25 mile of suitable foraging habitat (USFWS 1996). Dredging and disposal will occur in suitable foraging habitat, but associated effects will be in a localized area with respect to this species' foraging range. Marbled murrelets are relatively opportunistic foragers; they have a flexibility in prey choice which likely enables them to respond to changes in prey abundance and location (USFWS 1996). This indicates that if murrelets are present in the immediate vicinity of maintenance activities and they are if disturbed while foraging, they would likely move without significant injury.

As discussed in Section 5, dredging and disposal operations are not expected to result in a long-term reduction in the abundance and distribution of murrelet prey items. Increases in turbidity associated with maintenance work could reduce visibility in the immediate vicinity of dredging activities, thereby reducing foraging success for any murrelets that remain in the area. Any reduction in availability of food would be highly localized and would subside rapidly upon completion of the dredging and disposal operations.

Determination of Effect

The proposed project is **not likely to adversely affect** the marbled murrelet since the project will have no effect on nests or nesting habitat. Any disruption to foraging activities and the murrelet prey base are expected to be insignificant, since they would be highly localized relative to this species' foraging range.

7.11Bull Trout

The Coastal/Puget Sound bull trout population segment was listed as a threatened species under the Endangered Species Act of 1973, as amended in October 1999. Bull trout populations have declined through much of the species' range; some local populations are extinct, and many other stocks are isolated and may be at risk (Rieman and McIntyre 1993). A combination of factors including habitat degradation, expansion of exotic species, and exploitation have contributed to the decline and fragmentation of indigenous bull trout populations.

Bull trout are known to exhibit four types of life history strategies. The three freshwater forms include adfluvial forms, which migrate between lakes and streams; fluvial forms, which migrate within river systems; and resident forms, which are non-migratory. The fourth and least common strategy, anadromy, occurs when the fish spawn in fresh water after rearing for some portion of their life in the ocean.

Bull trout spawning usually takes place in the fall during September and October. Initiation of breeding appears to be related to declining water temperatures. In Washington, Wydoski and

Whitney (1979) reported spawning activity was most intense at 5 to 6^{o}C. Spawning occurs primarily at night. Groundwater influence and proximity to cover are reported as important factors in spawning site selection. Bull trout characteristically occupy high quality habitat, often in less disturbed portions of a drainage. Necessary key habitat features include channel stability, clean spawning substrate, abundant and complex cover, cold temperatures, and lack of barriers which inhibit movement and habitat connectivity (Reiman and McIntyre, 1993).

Juvenile bull trout, particularly young of year (YOY), have very specific habitat requirements. Small bull trout are primarily bottom-dwellers, occupying positions above, on or below the stream bottom. Bull trout fry are found in shallow, slow backwater side channels or eddies. The adult bull trout, like its young, is a bottom dweller, showing preference for deep pools of cold water rivers, lakes and reservoirs (Moyle 1976).

Bull trout movement in response to developmental and seasonal habitat requirements make their movements difficult to predict both temporally and spatially. A recent WDFW (1999) summary paper on bull trout in Stillaguamish Basin does give some general information on bull trout distribution in Puget Sound river basins. Newly emergent fry tend to rear near spawning areas, while foraging juvenile and sub-adults may migrate through river basins looking for feeding opportunities. Post-spawn adults of the non-resident life form quickly vacate the spawning areas and move downstream to forage, some returning to their “home” pool for additional rearing. Anadromous sub-adults and non-spawning adults are thought migrate from marine waters to freshwater areas to spend the winter.

Based on research in the Skagit Basin (Kraemer 1994), bull trout juveniles migrate to the estuary in April-May, then re-enter the river from August through November. Most adult fish entered the estuary in February-March, and returned to the river in May-June. Sub-adults, fish that are not sexually mature but have entered marine waters, move between the estuary and lower river throughout the year.

Known Occurrences in the Project Vicinity

The status of bull trout in Grays Harbor, particularly the species’ migration patterns within the estuary, is largely unknown. The seven major rivers that drain into Grays Harbor are characterized by a relatively low gradient, elevations below 2000 feet, and dominant winter peak flows with a lack of spring snowmelt—all conditions less than optimal for bull trout.

A bull trout subpopulation is known to occur in the Chehalis Basin, however it is not known if this population is fluvial or anadromous. Spawning timing and locations for bull trout in the Chehalis Basin are unknown (WDFW and WA Treaty Tribes 1994). It is thought that they spawn only in the Olympic drainages to the Chehalis, as elevations in the Willapa Hills drainages are too low (Goetz 2000). Some researchers suspect that there is not a significant spawning population in the Chehalis, and that fish in the area are from rivers on the Olympic Peninsula where significant spawning populations are present (Deschamps and Wright 1970, as cited in USFWS 2000).

Bull trout in the Coastal-Puget Sound population segment have declined in abundance and distribution within several individual river basins; since the Chehalis is located near the southern extent of the species, abundance may be naturally low (USFWS 1999). In recent years there have been fewer reports of incidental catches of bull trout and Dolly Varden in the Chehalis Basin (USFWS 1999). Little historical and current information is available on potential causes of population declines, though habitat degradation has adversely affected other salmonids in the system and is assumed to have similarly affected bull trout (USFWS 1999).

Effects of the Action

Bull trout do not spawn in the lower Chehalis or Grays Harbor, so there will be no effect on spawning behaviors or habitat. Any juvenile bull trout in the lower mainstem would be found in shallow, slow backwater side channels or eddies well away from the navigation channel. These reaches will be dredged using a clam shell dredge, which allows ample time for any bull trout located in the navigation channel to escape direct injury by dredging apparatus. Since this portion of the navigation channel is highly industrialized and has few remaining vegetated banks, it is thought that bull trout will use this portion of the channel for migratory purposes only. The bull trout life history stages requiring the lowest fine sediment levels—spawning, incubation, and fry rearing—occur in headwater streams and small tributaries far upstream of the navigation channel.

Potential adverse effects of dredging and disposal activities include exclusion of bull trout from their habitat through a reduction in water quality, and the loss of prey resources through habitat disturbance and entrainment (USFWS 2000). These effects were discussed in greater detail in Section 5. Adverse impacts will be largely avoided by timing restrictions protective of bull trout's most critical life history stages in the lower portion of a watershed: juvenile downstream migration and adults returning to the estuary in poor condition after spawning (USFWS 2000).

The USFWS has established a bull trout closure period in Puget Sound but not for coastal streams. In January 2000, John Grettenburger (USFWS) indicated that this closure window, February 15 through July 15, would apply to Grays Harbor. Fred Seavey (USFWS) later indicated that the closure applied only to the inner reaches (Elliott Slough, South Aberdeen, Cow Point, and Hoquiam) and not the outer reaches (North Channel, Inner and Outer Crossover, South Reach, Entrance, and Bar Channel). This is because the estuary is quite wide in the outer reaches, so a smaller proportion of the migratory pathway is affected by sediment plumes and the relative distance between dredging activities and shallow subtidal habitat is greater.

Determination of Effect

The Corps has determined that the proposed project is **not likely to adversely affect** bull trout. This determination is based upon the minimization of direct impacts that will result from maintenance operations by scheduling work outside of fish closure periods specified by USFWS. There would be no effects to spawning habitat or behaviors. Potential effects of any disruptions to feeding would be discountable.

7.12 Coastal Cutthroat Trout

The Southwest Washington/Columbia River ESU coastal cutthroat trout was proposed as a threatened species under the Endangered Species Act of 1973, as amended in April 1999. Grays Harbor and the Chehalis Basin are included in this ESU.

Coastal cutthroat trout exhibit a complex life history pattern with respect to reproductive and migratory behaviors. Multiple life-history forms frequently coexist within the same watershed and even the same stream (June 1981). Although all coastal cutthroat trout populations with access to the sea are believed to have an anadromous component, not all members migrate to the sea. Most cutthroat trout that enter seawater do so as 2 or 3-year-olds, but some remain in freshwater for up to 5 years before entering the sea (Giger 1972).

Coastal cutthroat spawn in small tributaries of large or small streams with a drainage area of less than 13 km^2; they are known to spawn in numerous river systems throughout Western Washington. Adult returns are associated with stream size and marine access (Johnston 1982). Spawning usually occurs upstream of coho salmon and steelhead spawning zones, although some overlap may occur (Lowry 1965). Cutthroat trout are iteroparous, able to spawn multiple years, and some fish have been documented to spawn for at least 5 years, although some do not spawn every year and some do not return to seawater but instead remain in freshwater for at least a year (Giger 1972, Tomasson 1978).

Coastal cutthroat enter natal streams to feed and spawn from July to February—generally September to October for larger rivers, and January to February for small streams. Spawning occurs from December through May, and alevins emerge from gravel during June and July (Johnston 1982). In Washington and Oregon, the return of spawned-out adults to salt water peaks in late March and early April (Trotter 1997). Juveniles rear in freshwater for 2 to 3 years, then migrate to estuaries and nearshore marine waters to feed during April and May. Juveniles and adults usually remain close to their natal estuary, and sometimes overwinter in freshwater streams.

Coastal cutthroat trout that enter marine waters are reported to move a moderate distance along the shoreline, but do not cross large bodies of open water (Pearcy 1997). However, offshore sampling studies with fine meshed purse seines captured coastal cutthroat trout between 10 and 46 km offshore (Pearcy et al. 1990). The relative importance of the marine phase of the life cycle may vary among populations depending on conditions in estuaries and nearshore habitats (Reeves et al. 1997). In some cutthroat trout populations, only a small portion of the individuals may be anadromous (DeWitt 1954, Gerstung 1997).

Sea-run cutthroat trout in Willapa Bay and Grays Harbor are a mixed stock of natural and hatchery fish. The primary hatchery facility in southwestern Washington is the Lake Aberdeen Hatchery which began rearing a mixed coastal cutthroat captive broodstock in the early 1980s (National Research Council 1996). It is estimated that a total of about 37,000 fish annually enter the tributaries of Willapa Bay and Grays Harbor, primarily from the mixed stock reared at the Lake Aberdeen Hatchery (Leider 1997).

Known Occurrences in the Project Vicinity

Washington's southwest coast stocks, including those in the Grays Harbor basin, have life histories similar to Puget Sound stocks; most spend their entire life cycle without leaving stream and estuary zones (Leider 1997). In Grays Harbor adult in-migration generally occurs during from October through April (WDFW 2000), adult outmigration peaks in late March and early

April, and juvenile outmigration usually takes place during April and May (Trotter 1997 and Leider 1997).

Effects of the Action

Potential adverse effects of dredging and disposal activities include exclusion of sea-run cutthroat from their habitat through a reduction in water quality, and the loss of prey resources through habitat disturbance and entrainment. These effects were discussed in greater detail in Section 5.

Adult and juvenile sea-run cutthroat migrate into the estuary during work closure periods; like bull trout, these are the two most sensitive life history stages to occur in the lower portion of river basins. A large portion of adult upstream migration into the Chehalis River occurs during the period in which the inner harbor reaches are dredged. While turbidity and other dredging-induced water quality degradation may divert or delay adult cutthroat from their migratory paths, these fish would be large and mobile enough to avoid direct physiological impacts. The life history stages requiring the lowest fine sediment levels—spawning, incubation, and fry rearing—occur upstream of the navigation channel.

While juvenile density sampling and trap returns indicate that cutthroat are relatively abundant and widely distributed in the Chehalis Basin (WDFW 2000), there is concern about declines in the anadromous form, particularly in the lower Columbia (NMFS and USFWS 1999). Any migration delays caused by dredging in the inner harbor will not significantly increase the risk of extinction of the anadromous form in the Chehalis Basin.

Determination of Effect

The Corps believes this project **will not jeopardize the continued existence** of the Lower Columbia River/Southwest Washington ESU sea-run cutthroat trout. In the case that this species is listed during the term of this BA, consultation will be re-initiated and dredging schedules would be modified in order to comply with any timing restrictions implemented by USFWS.

7.13 Humpback Whale

In 1970 the humpback whale was listed as a endangered species under Endangered Species Conservation Act of 1969. The humpback is currently listed as endangered under the Endangered Species Act of 1973, as amended.

Humpbacks are a highly migratory species. Two types of migrations are distinguished: within-season movements through a portion of the summer range, presumably to find or follow concentrations of prey, and long-distance migrations between summering and wintering areas (NMFS 1991). The summer range of humpbacks extends from subtropical waters to the arctic and the species winters in tropical waters, where mating and calving occur. During the summer, North Pacific humpbacks feed in coastal areas; greatest numbers generally occur off the Aleutian Islands and California coast. The primary prey item of humpback whales is euphausiids, but they also feed on schooling fish such as anchovies, herring, sand lance, capelin, sardines, cod, and juvenile salmonids (Nitta and Naughton 1989). When not migrating, they occur very close to shore. Humpbacks visit coastal and inside waters more often than other large whale species, with the exception of the gray whale. At one time humpbacks were one of the most frequently sighted whales in Washington's inside waters.

Barlow (1994) identified four relatively separate migratory populations in the North Pacific: the coastal California/Oregon/Washington-Mexico stock, the Mexico offshore island stock, the central North Pacific stock (Hawaii/Alaska), and the western North Pacific (Japan) stock. The coastal California/Oregon/Washington-Mexico stock ranges from Costa Rica to southern British Columbia, but is most common in coastal waters off California in the summer/fall and Mexico in the winter/spring (Barlow et al. 1997). In 1996, the minimum population estimate for this population was 563; the coastal California/Oregon/Washington-Mexico stock appears to be increasing in abundance (Barlow et al. 1997).

In 1965, the International Whaling Commission banned the commercial harvest of humpback whales in the North Pacific. Current threats to humpback populations include entanglement in offshore drift gillnets and ship strikes. It is thought that increasing levels of anthropogenic noise in the world's oceans may also impact whales, particularly baleen whales like the humpback that may communicate using low-frequency sound (Barlow et al. 1997). Based on whaling statistics, the pre-1905 humpback population in the North Pacific can be estimated at 15,000. By 1966, this population was reduced to approximately 1,200. The North Pacific population is now thought to exceed 3,000 (Barlow 1994).

Known Occurrences in the Project Vicinity

Based on aerial and shipboard surveys between 1975 and 1994, humpbacks are the second most abundant (after the gray whale) large whale off of Washington and Oregon (Barlow et al. 1997). The summer distribution of humpbacks is linked to local distribution of prey, which is driven by physical oceanographic conditions; factors such as upwelling and converging currents, which are characteristic of fjords, channels, continental shelves, offshore banks, and the edges of continental shelves, affect the abundance and availability of prey items (NMFS 1991).

Effects of the Action

Potential effects to humpbacks as a result of the proposed work largely relate to possible sound disturbance caused by dredging and disposal. Whale responses to sound disturbance may include avoidance, startle, annoyance, and slowed rate of travel (Calambokidis et al. 1987). As discussed in Section 5, dredging and disposal operations are not expected to result in a long-term reduction in the abundance and distribution of prey items. Any reduction in availability of food would be highly localized and would subside rapidly upon completion of the dredging and disposal operations. Short-term impacts of any disturbance related to channel maintenance activities would likely result in displacement of animals rather than injury. The potential for long-term or indirect impacts of the proposed work to humpbacks is minimal.

Determination of Effect

The proposed project is **not likely to adversely affect** the humpback whale since the potential for significant sound disturbance or impacts to water quality and prey abundance is minimal.

7.14 Steller Sea Lion

The Steller sea lion was listed as a threatened species under the Endangered Species Act of 1973, as amended in November 1990. In 1997, the North Pacific's population of Steller sea lions was separated into two distinct stocks, one of which was reclassified as endangered. The status of the eastern stock, which includes the population inhabiting the waters of the Washington coast, remains unchanged.

The present range of the Steller sea lion extends from northern Japan, through the Bering Sea and Aleutian Islands, along Alaska's southern coast, and south to California. The centers of abundance and distribution lie in the Gulf and Alaska and Aleutian Islands. Steller sea lions are not known to migrate, but they do disperse widely during portions of the year other than the breeding season. Most information on the distribution of Steller sea lions has been collected during summer months, so their distribution during late fall and winter is poorly known (Steller Sea Lion Recovery Team 1992).

When not on land Steller sea lions are generally seen inshore, less than 5 miles from the coast. Steller sea lion foraging patterns vary depending upon age, season, and reproductive status, as well as the distribution and availability of prey. Foraging patterns of females during the winter months vary considerably; individuals travel an average of 133 km and dive an average of 5.3 hours per day. The vast majority of feeding dives occur to a depth of 100 m. The diet of Washington's Steller sea lions is not well known; primary prey items may include cod, pollock, rockfishes, herring, and smelt (Gearin and Jeffries 1996). They appear to be largely opportunistic feeders.

Two types of terrestrial habitats are utilized by Stellar sea lions: rookeries are areas where adults congregate for breeding and pupping, and haul-outs are areas used for rest and socializing. Sites used as rookeries during the breeding season may be used as haul-outs during the remainder of the year. Steller sea lions haul-out on offshore islands, reefs, and rocks, while rookeries generally occur on beaches. Preferred rookeries and haul-out areas are located in relatively remote areas where access by humans and mammalian predators is difficult; locations are specific and change little from year to year (Steller Sea Lion Recovery Team 1992).

During the past 30 years, Steller sea lion populations have suffered a dramatic decline. Numbers in the rookeries of central/southern California, the central Berring Sea, and in the core Alaskan ranges have all decreased substantially. A number of natural and anthropogenic factors have been hypothesized as contributing to these declines, but a primary cause has not been definitively identified. It is generally thought that a nutritional deficiency resulting from a lack of abundance or availability of suitable prey is involved (Steller Sea Lion Recovery Team 1992). Major shifts in the abundance of fish in the Berring Sea over the past several decades are well documented (WDFW 1993). The Alaska pollock and Atka mackerel fisheries have specifically been implicated in decreasing the availability of prey. A similar decline has not been documented in the region from southeast Alaska through Oregon, where Steller sea lion numbers appeared to have remained stable (Steller Sea Lion Recovery Team 1992).

Known Occurrences in the Project Vicinity

Steller sea lions may be observed along the Washington coast year round, but they are most abundant during March-April and August-November, and least abundant during breeding season in May-July (Gearin and Jeffries 1996). No breeding rookeries have been identified in Washington waters; however, in 1992 a single pup was born on Carroll Island (WDFW 1993).

The majority of Washington's Steller sea lion haul-out sites are located along the northern outer coast. Major haul-out sites are concentrated at large rock complexes including Tatoosh Island, Cape Alva, Carroll Island, Split/Willoughby rocks, and the Columbia River South Jetty (Gearin and Jeffries 1996). Grays Harbor has several documented haul-out areas used regularly by harbor seals, but there is no indication that these sites are used regularly by Steller sea lions (Jeffries et al. 2000).

Effects of the Action

Given the lack of rookery and major haul-out areas in and near Grays Harbor, when in the vicinity Steller sea lions are likely on foraging expeditions. Dredging activities will have no effect on breeding habitat or behavior. Noise associated with dredging operations may have an effect on foraging behavior. Short-term impacts of any sound disturbance related to construction activities would likely result in displacement of animals rather than injury.

As discussed in Section 5, dredging and disposal operations are not expected to result in a long-term reduction in the abundance and distribution of Stellar sea lion prey items. Increases in turbidity associated with maintenance work could reduce visibility in the immediate vicinity of dredging activities, thereby reducing foraging success for any animals in the area. Any reduction in availability of food would be highly localized and would subside rapidly upon completion of the dredging and disposal operations.

No haul-out sites will be physically disturbed by dredging and disposal operations. The potential for long-term or indirect impacts of the proposed project to Steller sea lions is minimal.

Determination of Effect

The Corps believes this project is **not likely to adversely affect** the Steller sea lion since the potential for significant sound disturbance or impacts to water quality and prey abundance will be minimal.

7.15 Lower Columbia River/Southwest Washington ESU Coho

The Lower Columbia River/Southwest Washington ESU coho salmon was declared a candidate species under the Endangered Species Act of 1973, as amended in July 1995. Grays Harbor and the Chehalis Basin are included in this ESU.

Coho salmon have one of the more predictable life histories of the Pacific salmon. After 1 or 2 years in ocean waters, adult coho return to Grays Harbor from mid- to late September through mid-December, enter their parent rivers in beginning in October, and begin to spawn in November (WDFW and Washington Treaty Tribes 1994). Coho larvae spend 2 to 3 weeks absorbing the yolk sac in the gravels of the redd before they emerge. Juvenile coho salmon then rear in freshwater for approximately 15 to 18 months prior to migrating downstream to the ocean. Newly emergent fry usually congregate in schools in pools of their natal stream. As juveniles grow they move into riffle habitat and aggressively defend their territory, resulting in the displacement of excess juveniles downstream to less favorable habitat (Wydoski and Whitney 1979). This aggressive behavior may be an important factor maintaining the numbers of juveniles within the carrying capacity of the stream, and distributing juveniles more widely downstream. As territories are established, individuals rear in selected areas of the stream and feed on drifting benthic organisms and terrestrial insects. Territories expand as juveniles grow. Feeding and growth slow considerably in the fall and winter, as food production and fish metabolisms slow. Coho seek off-channel sloughs and ponds in which to spend the winter.

Known Occurrences in the Project Vicinity

Coho are found in nearly all significant streams throughout the Grays Harbor drainage (WDFW and Washington Treaty Tribes 1994). Adult upstream migration into the Chehalis occurs from October through mid-December, while juvenile out migration occurs from March to June.

Effects of the Action

Potential adverse effects of dredging and disposal activities include exclusion of coho from their habitat through a reduction in water quality, and the loss of prey resources through habitat disturbance and entrainment. These effects were discussed in greater detail in Section 5. Adverse impacts will be largely avoided by timing restrictions protective of Cohoes most critical life history stage in the lower portion of a watershed, juvenile downstream migration.

While turbidity and other dredging-induced water quality degradation may divert or delay adult coho from their migratory paths, these fish would be large and mobile enough to avoid direct physiological impacts. The life history stages requiring the lowest fine sediment levels—spawning, incubation, and fry rearing—occur upstream of the navigation channel. The migration delay, while an adverse effect, will not significantly increase the risk of extinction of the coho in the Chehalis Basin.

8. INTERRELATED AND INTERDEPENDENT ACTIONS

No interrelated or interdependent actions are associated with the project described in Section 3. Since dredged material disposal is interrelated with channel dredging, both actions were evaluated in this document.

9. CUMULATIVE AND SECONDARY EFFECTS

Periodic maintenance dredging/disposal projects by the Port of Grays Harbor and Weyerhaeuser Timber Company have effects similar to those described herein, but would occur in a more localized area over a shorter period of time. These types of projects occur every few years, usually in areas that shoal frequently. Corps-issued Section 404 permits for these non-federal projects will ensure that work will not occur during fish closure windows, so as to reduce potential impacts to listed species.

The Corps knows of no other future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this evaluation. Future Corps actions unrelated to the proposed action are not considered here because they require separate evaluations.

10. CONSERVATION MEASURES

The following management actions will be implemented before or during construction activities. Construction conditions will be included in project contracting specification documents. A Corps inspector would be on-site to ensure that contractors abide by these requirements.

1) Hold a meeting with the dredging contractor to discuss ways to minimize water quality impacts during dredging and disposal operations.
2) Adhere to the Washington Department of Ecology's Water Quality Certification and the Washington Department of Fish and Wildlife's Hydraulic Project Approval. Dredging will not occur during WDFW fish closure periods.
3) Conduct dissolved oxygen monitoring during nearshore disposal in Half Moon Bay. Disposal operations will be halted if dissolved oxygen levels fall below state guidelines. Monitoring methods will be consistent with those specified in the Water Quality Certification.

In addition to these measures, which will avoid and/or minimize effects to salmonids, the Corps is currently working to develop, in cooperation with the USFWS, City of Westport, and Port of Grays Harbor, a comprehensive plan to guide future dredging and disposal operations in Grays Harbor. The Corps is also conducting research in order to make more informed decisions on maintenance dredging. Research activities include:

1) Conducting genetic tests on native char from the Chehalis River, in cooperation with other agencies, to confirm the presence of bull trout and/or Dolly Varden.
2) Modeling and monitoring the fate of dredge plumes during a variety of tidal conditions to determine spatial water quality characteristics (e.g., nutrients, dissolved oxygen, dissolved organic matter, turbidity, and suspended sediments) of the plume.
3) Conducting a three-year monitoring plan of the inner reaches, in cooperation with the USFWS, to establish the patterns of bull trout use and substantiate fish closure windows.

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